THURSDAY, DECEMBER 29, 1887.

THE ROSICRUCIANS.

The Real History of the Rosicrucians. By Arthur Edward Waite. (London: George Redway, 1887.)

WE have since the receipt of this work for review endeavoured to ascertain what notions existed in the brains of our acquaintances on the subject of the Rosicrucians, and have posed the question "Who and what were they?" to many sorts and conditions of men. The minds of many were absolute blanks on this subject: some thought it was the name of a benefit society—some that it was a kind of freemasonry. One gentleman knew Rosicrucian as "the winner of the Alexandra Plate at Ascot in 1871," and but few had any intelligible notion on the matter. We do not estimate our neighbours at a much lower rate than the average; and it may therefore be granted that there is a large section of the British public to whom the Rosicrucians and their doings are unbroken ground, and that there is ample justification for the appearance of a book which is calculated to dispel the prevailing ignorance.

Mr. Waite has already made "the mysteries of magic" his theme, and consequently comes before us as no uncertain guide in the mazes of the occult. In his present work he furnishes a sketch of the state of mystical philosophy in Germany at the close of the sixteenth century, when the Reformation had removed their fetters from the inquirers. Of these there were many, for men's minds seethed with an infinity of speculations, as well philosophical as religious. The Neo-Platonic philosophy, which had lingered throughout the Middle Ages, once again came into more extended repute, and was professed by various disciples, until German mysticism culminated with Paracelsus. It was at such a period of complex opinions and of mystical ways of thought that the existence of the Rosicrucian fraternity was first revealed to the world. The manifestoes put forth by the brotherhood consisted of the "Fama Fraternitatis; or a Discovery of the Fraternity of the most Laudable Order of the Rosy Cross," and of the "Confessio Fraternitatis R.C. ad Eruditos Europæ." In the latter work are incorporated "thirty-seven reasons of their purpose and intention": these condemn the Pope and Mahomet; offer vast treasure to the head of the Roman Empire; disparage the moribund philosophy of the day, offering in its place the meditations of the brethren, who arrogate to themselves an acquaintance with what is transacted in the farthest regions of the earth. Great promises of a general reformation are made; the knowledge of Nature is eulogized beyond the transmutation of metals or the possession of the supreme elixir. The Society professes to accept the Bible as its oracle, whilst it sagely condemns the innumerable expounders who "make a sport of Scripture as if it were a tablet of wax." The brethren were apparently unsuccessful as linguists, for they are careful to explain that having the use of a magic writing and language they are not so eloquent in other tongues, "least of all in this Latin, which we know to be by no means in agreement with that of Adam and of Enoch."

In the "Fama Fraternitatis" we have an exposition of their religious views, a condemnation of "ungodly and accursed gold-making," an offer of communion to such as shall seek them in sincerity, and an account of their origin. They claim that their founder was brother C. R. C. (subsequently identified with Christian Rosencreutz), a noble German born in 1378. At five years of age he was placed in a cloister, "where he learned indifferently the Greek and Latin tongues," and started with one of the monks for Jerusalem. The monk died, and brother C. R. C. never reached his destination; but his skill in physic obtained for him the favour of the Turks, and becoming acquainted with the wise men of "Damcar," in Arabia, he came thither at the age of sixteen. The unfortunate fact that "Damcar" is unknown to chorographers prevents our gratifying our readers by identifying its locality. Here he was received by the learned as one long expected, and was initiated into their arcane wisdom. Thus primed, he came, three years later, to Egypt, and thence to Fez, where he acquired cognizance of the elementary inhabitants, who revealed unto him many of their secrets. After two years he set sail for Spain to confer with the learned, generously offering to correct their errors in moral philosophy and in the arts, as well as the abuses obtaining in matters ecclesiastical. His proposals were, for some unaccountable reason, slighted by the Spanish *savants*, and the misprized brother returned to Germany, gathered round him a few disciples, founded the fraternity of the Rosy Cross, and died at the ripe age of one hundred and six. His tomb was after the lapse of one hundred and twenty years discovered, together with many mystical adjuncts, in a concealed vault. His fair and worthy body was found whole and unconsumed, and resting in proximity to the *Vocabularium*, *Itinerarium*, and Life of Paracelsus. From the "Fama" we learn that the brotherhood acknowledged the divinity of Jesus, the resurrection, a personal devil, two sacraments, the Bible as "the whole sum" of their laws, and the Pope as Antichrist. Such were their religious beliefs. In philosophy they sought a universal synthesis; they aimed at the substance at the base of all the vulgar metals; they held, although they did not originate, the doctrine that self-propagating elemental beings people earth, air, fire, and water, and believed in the *signatura rerum*, a "certain organic vital activity," which is frequently expressed in the exterior form of things, indicating their interior qualities. They seem to have used some form of practical magic, and accepted as fact the transmutation of metals and the existence of "the supreme medicine of the world." With such a nostrum in their possession the least they could do was to heal the sick, and they were accordingly charged to do so gratuitously. The whole manifesto concludes with a declaration that, although making no mention either of their names or meetings, everyone's opinion should come to their hands, in what language soever it be, and that none giving their names should fail to receive a personal visit or a written communication.

Unfortunately, the assertions contained in the publications of the brotherhood are, as Mr. Waite shows, confuted by a critical examination. We are asked to accept the fabulous oriental city, the youth of brother R. C., in spite of his precocious skill in physic, and his erection of a House of the Holy Spirit, where an "unspeakable concourse of

the sick" thronged for cure notwithstanding the fact that the Society remained unknown to Europe till the beginning of the seventeenth century. Thus much we might even be induced to swallow on the *credo quia impossibile est* principle; but the finding, in 1494, of the works of Paracelsus, who had been born in the previous year at Einsiedeln, staggers our faith. Courtesy forbids the lie direct, but, to use a phrase of Mr. Newell's, we incline to think that if the author of the "Fama" ever wrote a work of fiction it would sell.

We have, then, to seek elsewhere for an explanation of the Society's inception, and must do so in post-Lutheran times; the violence of its anti-Papal prejudices, and its ultra-Protestant principles, prohibiting the attribution of its origin to a more remote period. It will render the comprehension of the case more easy if, before theorizing as to the foundation of the Rosicrucians, we note the varying opinions which have obtained as to the signification of the letters F.R.C., which formed the title of the brotherhood, and as to the badge which they employed.

Michael Maier conceived that R. signified Pegasus, and C. *lilium*; others that R. was *ros*, dew, and C. *crux*, cross, dew being deemed the most powerful dissolvent of gold, and the cross being in chemical language equivalent to light—the menstruum of the red dragon, the producer of gold—since the letters L V X are all formed by the limbs of the cross. Again, it has been imagined that F.R.C. stood for Fratres Roris Cocti, or dew digested for the work of transmutation. The Society's published documents, however, sanction the generally received opinion that R. is for *rosa*, rose, and C. for *crux*, cross, and that the letters F.R.C. are the initials of Fratres Rosatæ Crucis.

The device of the Society is a red rose on a red or golden cross, this being usually placed on a calvary. Mr. Waite has some interesting memoranda upon the occult significance of the rose as the feminine emblem contrasting with the masculine cross; of the Brahmanic rose, the residence of the Deity, recurring with similar significance in Dante's Paradise; of Buddha and Indra crucified for stealing the blossom; of the identification of Jesus with the crucified flower; of the rose of Bacchus which enabled Midas to turn all things to gold; of that of Harpocrates consecrated to silence; and so forth. He cites the author of the "Summum Bonum," who sees in the symbol "the cross sprinkled with the rosy blood of Christ"; and the Abbé Constant, who has identified the rose with scientific initiation and the cross with religion, and beholds in their conjunction that happy union the antithesis of which has been chronicled by Mr. Draper. He is nevertheless fain to confess that the whole question of the significance of the crucified rose in its connection with the Society is one of pure conjecture, and that no presumption is offered by the fact of its adoption for its connection with universal symbolism.

Mr. Waite divides the Rosicrucian theorists into three categories. Firstly, such as accept the history of Christian Rosencreutz as that of an actual personage and the "Fama Fraternitatis" as a true history. These he regards as impervious to argument. Accepting the dictum of De Quincey, that the "Fama" is "monstrous and betrays itself in every circumstance," he decides that the legend of Christian Rosencreutz is not historically true, and that the Society did not originate as described. In the second section he places those who regard both personage and relation as mythical; and, in the third, believers in the existence of the secret Society, but who reject the "Fama" as a fiction.

The theorists of these latter categories have mostly sought the author of the Rosicrucian manifestoes amongst the *literati* of the period, whether they regarded him as a hoaxer or a satirist or as the spokesman of a hidden brotherhood. By them the publications in question have been variously attributed to Taulerus, Luther, Wiegel, Joachim Junge, Ægidius Gutmann, or Johann Valentin Andreas. Mr. Waite considers that it is only in the case of the last named that there is any sufficient evidence to support the plea of authorship. The grounds upon which that plea rests are, amongst others, that the writings of Andreas show him to have uniformly favoured secret Societies as a means for the reformation of his age and country. He is the acknowledged author of a work entitled the "Chymical Marriage of Christian Rosencreutz"—a species of alchymical "Pilgrim's Progress," which, after remaining several years in manuscript, was printed at Strasburg in 1616, and a translation of which occupies 97 pages of the present volume. The first manifestoes of the Society had only borne the initials C. R. C.; but the issue of 1615 calls it the Bruderschafft des Rosen-Creutzes, and it is hence argued that the manifestoes and the "Chymical Marriage" had a common author. The hero of the latter work binds a blood-red ribbon cross-wise over his white linen coat, and sticks four roses in his hat—a noteworthy coincidence, the arms of the Andreas family being a saltier between four roses. The connection of this escutcheon with the device of the crucified rose has been urged, as also the identity of the acknowledged principles of Johann Valentin with those set forth in the manifestoes, in favour of his authorship. This opinion has gained support from certain utterances of Prof. Besoldt, himself an intimate friend of Andreas. Against this view it must be remembered that Andreas describes the "Chymical Marriage" as a *ludibrium* of his youth, though he must have been aware that its alchymical contents would certainly be accepted seriously when published in his maturer years; and it is submitted that he, a man of known intellectual nobility, could scarcely have perpetrated a hoax the reprehensible nature of which he had himself stigmatized when dealing with the Rosicrucian manifestoes. Again, the accepted symbol of the fraternity was never a saltier between four roses, but either a Latin cross with a rose at the point of intersection or a cross rising out of a rose. The identification of the arms of Andreas with a badge of the brotherhood, which forms one of the strongest arguments in favour of his authorship, thus falls to the ground. These and other arguments elaborated by Mr. Waite suffice to render it very uncertain that the Rosicrucian publications emanated from Andreas. Mr. Waite suggests that Andreas may have been associated with the previously existing Militia Crucifera Evangelica, and, when disgusted with its assumption of occultism, have attempted to replace it by a practical Christian association free from mysticism and its symbols, from pretension to arcane endowments or transcendent powers. But he admits that undoubted difficulties beset this theory, and adds: "To my own mind it is far from satisfactory, and, from a careful consideration of all available materials,

I consider that no definite conclusion can be arrived at." He further declares that the esoteric form of the Society's symbol was a rose in the centre of which is figured a Latin cross: he calls attention to the seal of Luther, on which a heart, surmounted by a cross, is inclosed by the outline of a rose, and hence gathers that the unknown founders of the Society chose this emblem, not from any recondite associations, but simply because the reforming monk was their idol.

With the case of Johann Valentin Andreas the interest of the work culminates. When we have learnt that nothing can be determined, and that there is every reason to believe that could we probe the heart of the mystery we should find little to reward our search, we care little for a record of the progress of Rosicrucianism in France and Germany, or for the writings and biographies of Rosicrucian apologists such as Michael Maier, Robert Fludd, Thomas Vaughan, and John Heydon. Artistically, this continuation is an anti-climax, and the chapters which compose it might have been fittingly relegated to the appendix, together with those remaining sections which are devoted to a refutation of the claims of the Freemasons and of modern Rosicrucian Societies to connection with the original fraternity of the Rosy Cross.

The claim which Mr. Waite puts forward to be considered an impartial historian we readily admit, for we have rarely seen a work of this description that was so free from all attempts at the distortion of facts to dovetail with a preconceived theory. His style is perspicuous, and contrasts most favourably with that of his Rosicrucian rival, Mr. Hargrave Jennings, against whom he tilts with much vigour throughout his pages.

The most interesting portions of the book are those where the author is willing to speak himself; for the lucubrations of the *illuminati*, which fill some 250 out of the 446 pages composing the work, are for the most part insipid and fatuous to the lay mind. It was doubtless necessary to include transcripts of the "Fama" and the "Confessio," these being the authoritative expositions of the Society's views, but we could have spared much of the "Chymical Marriage," and all of the "Universal Reformation of the Whole World by order of god Apollo," which Mr. Waite describes as a fairly literal translation of advertisement 77 of Boccalini's "Ragguagli di Parnasso, Centuria Prima," and which, he adds, "throws no light upon the history or claims of the Rosicrucians." Neither is much learnt from the speculations of the apologists, whose philosophy, although mysterious, is not to be readily identified with that of the fraternity as officially set forth. In wading through such documents, one is reminded of Mr. Shandy's exclamation when Rubenius has furnished him with information on every conceivable point except upon the one on which he sought for it. The work on the whole is well done and satisfactorily produced, but it lacks an index. Had the author furnished as good an index to his volume as the enterprising publisher, Mr. Redway, has added to his advertisements, he would have enhanced its value as a book of reference. To those students of occultism whose palates, undebauched by the intellectual *hashish* of the rhapsodies of mysticism and the jargon of the Kabala, can still appreciate a plain historical statement of facts we gladly commend the book.

THE MECHANICS OF MACHINERY.

The Mechanics of Machinery. By Alex. B. W. Kennedy, Professor of Engineering and Mechanical Technology in University College, London. (London: Macmillan and Co., 1886.)

ALTHOUGH the author explains in his preface that this work is destined to meet the requirements of young students of engineering, still the mathematical student of mechanics would reap immense benefit from a careful study of the novel treatment presented here, and would recognize the shortcomings and unsatisfactoriness of the treatises usually put into his hands.

Here we have a treatise on *real* mechanics, with diagrams, drawn accurately to scale, of *real* machines, and illustrative examples drawn from *real* life, while the ordinary mathematical treatise put into the student's hands is generally a great contrast, by reason of its abstract method of treatment, the unpractical nature of the problems discussed, and its diagrams resembling nothing that ever existed, purposely drawn badly, for the reason, it is urged, that a bad draughtsman can copy them more easily.

Prof. Kennedy, in his preface, explains how he has been driven to the vernacular use of the word "pound" as a name for a unit both of weight and of force, as "the adoption of any other plan would have made the book practically useless to almost all engineers so long as the thousand-and-one problems of their every-day work come to them in their present form." This plan is so perfectly clear and intelligible to ordinary practical men to whom dynamical problems on a large scale are a reality and not a mere theoretical abstraction that it is a pity that Prof. Kennedy has gone back on his principles in inserting in § 30, on force, mass, and weight, an attempt at explanation of the confusion of ideas in books on mechanics written by mathematicians, due to the introduction of the word "mass," a word which the engineer never requires.

The explanation of the relation between force, weight, and acceleration is so simple that it may very well be given here. Taking the gravitation unit of force, universally employed by our engineers, as the attraction of the earth on a weight of one pound, and calling this the *force* of one pound, then a force of f pounds acting on a weight of w pounds will produce acceleration a, such that $\frac{f}{w} = \frac{a}{g}$, by Newton's Second Law of Motion; or, $f = \frac{wa}{g}$.

But, if v is the velocity acquired in feet per second, and s the number of feet described in t seconds from rest, then it is shown in Chap. VII. of the present treatise that $v = at$, $\frac{1}{2}v^2 = as$; so that $ft = \frac{wv}{g}$, and $fs = \frac{wv^2}{2g}$.

Here fs represents the work done on the body in foot-pounds of work, and the dynamical equivalent is $\frac{wv^2}{2g}$ foot-pounds of kinetic energy.

So also the product ft is called the *impulse*, in *second-pounds*, of the force f acting for the time t, and its dynamical equivalent is $\frac{wv}{g}$ units of momentum, the momentum of w pounds moving with velocity v being defined by the product wv.

Now the mathematician noticed that in these equations the quantity w occurs divided by g, so he said, Let us call the quotient $\frac{w}{g}$ the "mass" of the body, and denote it by the letter m, so that $w = mg$, equivalent to taking g pounds as the unit of mass.

Unfortunately, in this way the "mass" of a body, which is the measure of an unalterable quantity, is now measured by a variable unit, while the "weight" of a body, which is now defined by the mathematician as the force with which the earth attracts the body, depending on the local value of g, is, although a variable quantity, always represented by the same number—namely, the number of pounds in the body.

This confusion is entirely obviated if, following the engineers, we discard the word "mass" altogether; if we measure, as is customary in ordinary life, weight in pounds, and if we change the unit of force to the absolute unit, called by Prof. James Thomson the "poundal." Now, if a force of p poundals acts on a weight of w pounds, it will produce acceleration a, such that $p = wa$, and then $pt = wv$, and $ps = \frac{1}{2}wv^2$, so that ps, the work done in foot-poundals, has the dynamical equivalent $\frac{1}{2}wv^2$ foot-poundals of energy; not, as the footnote to p. 248 would imply, that $\frac{1}{2}mv^2 = \frac{wv^2}{2g}$, because $m = \frac{w}{g}$, but because $\frac{1}{2}mv^2$ is the kinetic energy in foot-poundals of m pounds moving with velocity v; while the impulse pt second-poundals, has the dynamical equivalent of wv units of momentum.

The unit of momentum has not yet received a name, but the Committee on Dynamics of the Association for the Improvement of Geometrical Teaching is preparing to suggest a distinctive name.

Supposing then that w represents the weight of a body in pounds, how is it possible, as asserted on pp. 219, 220, that $\frac{w}{g}$ remains constant when the body is moved about to parts of the earth where g has different values? and where is the practical value of estimating the effective inertia in terms of the variable unit of mass, as in § 48, when the constant unit of weight would be simpler and practically more intelligible?

These theoretical questions of units of force and weight have been discussed here at some length, as it is important that Prof. Kennedy in his next edition should carefully revise this part of the subject, which will best be done if he disregards the discussions on "mass" of the ordinary text-books, and if he writes always in the ordinary vernacular language used by engineers.

In Chapter XII., on "Friction in Machines," the true laws of friction are given for the first time in any treatise in this country, Morin's illusory laws as usually taught being entirely discarded. With proper lubrication of machinery the question of friction is properly a question of viscous liquid motion. Some interesting applications, with graphical solutions to such problems as friction-brakes and pulley-tackle, are appended, which ought immediately to be incorporated into academical text-books. Of the same nature are the problems on train-resistance in Chapter IX.: a slip on p. 328 of introducing an extraneous factor, π, need only be mentioned here, as the author himself has already corrected it.

We have discussed the dynamical part of the book first, but it is the kinematical part, which treats of mechanism, which forms the greater half of the book. Here the author has analyzed the classification of machines and their elementary parts with great skill and clearness, and illustrated the theory with excellent diagrams. The idea of the "centrode" is largely used in the book, the invention of which is originally due to Belanger. While analyzing fully the centrodes of valve mechanism, the author has mysteriously stopped short of the discussion of valve diagrams, which, in the steam-engine, is the most important practical application of kinematics. Peaucellier's parallel motion is fully described, with Kempe's amplifications: it would be instructive to see a diagram of Peaucellier's motion as applied to an actual steam-engine. Pröll's velocity and acceleration diagrams are carefully explained, with extensions due to the author: this subject has received considerable development of late from German writers, and is capable of solving very elegantly such difficult and important practical problems as, for example, the determination of the bending moment at any point of a connecting rod.

A very useful table of moments of inertia concludes the volume, but here we should prefer to see k the radius of gyration, called in this book the radius of inertia, or rather k^2, the square of the radius, tabulated, side by side of the corresponding area A or volume V.

In conclusion, Prof. Kennedy's students are to be congratulated on the possession of such an admirable text-book, and it is to be hoped that the style and influence of its teaching will make itself widely felt outside of professional circles.

A. G. GREENHILL.

THE SOLOMON ISLANDS.

The Solomon Islands and their Natives. By H. B. Guppy, M.B., F.G.S., late Surgeon R.N. (London: Swan Sonnenschein, Lowrey, and Co., 1887.)

THE Solomon Islands, whether we consider the romantic narratives of their discovery and rediscovery, the comparatively unsophisticated character of their inhabitants, their faunistic and floral relationships, or their remarkable geological structure, are of more than common interest to the scientific world, and it is a matter for congratulation that their description has been undertaken by a traveller and historian so eminently qualified for the task as is Dr. Guppy. The book which he has produced is a rich storehouse of interesting and important observations, and will henceforth be an indispensable work of reference to every student of the races inhabiting the Pacific islands. It is worth while to lay stress upon this fact for the sake of encouraging future travellers to give their observations to the world, because Dr. Guppy did not at first intend to make any special investigation of the habits and manners of the inhabitants, but was led to do so by the want of interest displayed by those who seemed to have so much better opportunities.

The Solomon Islanders seem to be of various types in different parts of the group, but their prevailing characters are distinctly Melanesian or Papuan. A circumstance is pointed out which seems to indicate the Indian Archipelago as having been the route by which the Eastern Polynesians reached the Pacific. This circumstance

consists in the possibility of tracing the native names of certain trees across the Central Pacific from the Indian Archipelago to the Austral and Society Islands. For instance, in the former locality the *Barringtonia speciosa* goes by the names of *Boewa boeton* and *Poetoen;* in the islands of the Bougainville Straits in the Solomon Group it is called *Puputu;* in Fiji, *Vutu;* in Tonga, *Futu;* and in the Hervey and Society Islands, *E-Hoodu* or *Utu*. The name thus appears to have undergone a kind of progressive modification as the tree has receded from its original home. The large amount of information which Dr. Guppy has been able to collect is mainly due to his remarkable tact in dealing with the natives: he seems to have at once succeeded in establishing friendly relations with all those with whom he came in contact, and though he was continually in their power, going long journeys with no other escort than a body of them, he met with nothing but kindness at their hands. He modestly ascribes this satisfactory result mainly to the soothing influences of tobacco, without which, he says, the white traveller in these islands "is worse off than a man without any money in his purse in London," but something must undoubtedly be attributed to the kindly and conciliatory personal influence of the writer himself.

Where so much excellent matter is given it seems ungrateful to ask for more, but it is impossible to repress the desire for knowledge regarding the dwellers in the interior of these islands, who seem to be always at war with the coast tribes, and are regarded by them with so much contempt that "man-bush" is with the latter a common term of reproach. Very interesting, too, are the worked flints, not unfrequently found in the soil either during agricultural operations or after heavy rains. They may probably have been the work of the primitive Negrito race which was at one time widely spread over this region of the globe. It is worthy of notice that in none of the islands visited by the author was any chalk found which contained flints, but there are records of its existence in Ulaua, another member of the group.

Two chapters, certainly not inferior to the rest of the work in interest, are occupied by a history of our knowledge of this group of islands. It does not often happen that one who has distinguished himself as an explorer is willing to undertake a piece of literary work, calling for the patient and critical examination of an old manuscript, but it is a peculiarly happy chance that has thrown the translation of Gallego's journal into the hands of one whose exceptionally accurate knowledge of the locality has no doubt enabled him to avoid errors into which the best of scholars without such information must have fallen. Hernando Gallego was chief pilot to an expedition which was despatched from Peru under the command of Alvaro de Mendana for the ostensible purpose of spreading the Christian faith among the islanders of the Pacific. In the year 1567 they reached the Solomon Islands and gave names to most of them, but lest the English should attempt to possess themselves of the newfound territory no account of the discovery was published; and hence, after one or two futile attempts on the part of the Spaniards to refind and colonize them, knowledge of their whereabouts gradually became a vague tradition, and at length even their very existence was doubted. Two hundred years elapsed before Carteret sighted and anchored off the group, but he did not land. Then in rapid succession came the discoveries of Bougainville, Surville, Maurelle, and Shortland, but none of these identified their discoveries with the previous work of the Spaniards, and it was reserved for the genius of Buache to point out "that, between the extreme point of New Guinea as fixed by Bougainville and the position of Santa Cruz as determined by Carteret, there was a space of 12½° longitude, in which the Islands of Solomon ought to be found." His conclusion, that the islands seen by Carteret and others were the same as those previously discovered by the Spaniards, though long disputed, is now generally admitted, and justice has been rendered both to the gallant explorers and to the laborious and gifted investigator.

In reading this journal it is impossible not to wish that the chart accompanying the volume were on a somewhat larger scale, that more names had been inserted, and that the author, even if he did not feel at liberty to restore those given by the original discoverers, had at all events inserted them within parentheses.

Of Dr. Guppy's work in natural history it would be difficult to speak too highly. It embraces, in addition to a mass of anthropological material, to which reference has been made above, a general account of the chief divisions both of the animal and vegetable kingdoms. Special attention may be called to the observations upon floating seeds and seed-vessels, which have been utilized by Mr. Botting Hemsley in his work on the oceanic dispersal of plants, and to a remarkable fungous growth (*Pachyma*?) found lying loose upon the soil. Of reptiles, batrachians, and mollusca many new species were obtained; an interesting discussion is given regarding the origin of the edible birds'-nests, and an account of attempts to ascertain by direct evidence whether the *Birgus latro* is really able to husk and break cocoa-nuts for itself, as well as details of experiments on the power of various animals to resist submersion in sea-water. The Solomon Islands stand in a remarkable zoo-geographical position, on the boundary between the Polynesian and Indo Malayan regions, hence a special interest attaches to these lists of species and biological data. The size of the author's collections is little short of marvellous when it is remembered that for two out of the three years spent there his own cabin was the only place where he could store them. He seems, indeed, to have met with but scanty encouragement from those quarters whence he might reasonably have expected it, and every Briton should blush when he reads and reflects upon the truth of the closing words of Dr. Guppy's Introduction:—

"Stifling my own patriotic regrets, I cannot but think that the presence of Germany in these regions will be fraught with great advantage to the world of science. When we recall our spasmodic efforts to explore New Guinea and the comparatively small results obtained, when we remember to how great an extent such attempts have been supported by private enterprise and how little they have been due to government or even to semi-official aid, we have reason to be glad that the exploration of these regions will be conducted with that thoroughness which can only be obtained when, as in the case of Germany, geographical enterprises become the business of the State."

CROWN FORESTS AT THE CAPE OF GOOD HOPE.

Management of Crown Forests at the Cape of Good Hope under the Old Régime and under the New. By John Croumbie Brown, LL.D. (Edinburgh: Oliver and Boyd; London: Simpkin Marshall and Co., 1887.)

IN June last we noticed a work by Dr. Brown dealing with the schools of forestry in Germany, which, it appears, was the author's fifteenth volume on a variety of forest subjects. He has now presented the public with a new volume, out of a store of thirty said to be ready for publication. This plethora of forest literature showered upon us by Dr. Brown is becoming alarming. We pointed out on the previous occasion that the English reader has, in reality, very little interest to spare for forest questions, and what little does exist will certainly not be augmented by literature of the class under review. Here we have a goodly volume, comprising 352 pages of print, made up of a motley collection of old and new official reports, proceedings of an endless succession of Committees, &c., which, even if it were an official Blue-book, would have to be pronounced badly arranged and filled with quantities of irrelevant matter. We do not mean to say that there is not a silver thread running through the whole; what we desire to point out is that the information to be conveyed and the lesson to be learnt could with the greatest ease have been arranged in a pamphlet of thirty or forty pages. To scatter a few grains amongst a huge quantity of chaff is highly objectionable, and it is our duty to protest in the strongest terms against this class of book manufacture. The author had a really interesting story to tell, which, if placed before the public in a small pamphlet or an article in a periodical, would have been sure to attract attention, and might have done some good.

The story to which we refer is peculiarly English. It has been said that whenever we engage in war we generally begin by incurring some reverses: we then gather up our strength, and meet the enemy in such force that the strife is certain to end in success. If this holds good as regards our frequently occurring little wars, it seems to be no less applicable to our Civil administration, Looking, for instance, at our forest policy at the Cape, which Dr. Brown has brought before us in the present volume, it will be seen that after prolonged playing with the question, and after the forests had been well-nigh ruined, vigorous steps were taken to redeem the past.

As in most countries, the forests at the Cape were originally made use of by the population without let or hindrance. Then, with the arrival of European administration, came the colonist, who also betook himself to the woods, partly to clear the land for cultivation, partly to supply himself with material for his domestic requirements, and partly to cut and sell timber for the purpose of making a livelihood. The woodlands, which appeared sufficient to supply the wants of the native population, were soon found to be incapable of bearing the additional strain caused by a European Government and the inroads made by the accompanying colonist. Some enlightened person perceived that the forests could not last at the new rate of consumption of its produce, and raised the alarm. Inquiries were set on foot, officers reported, and Committees deliberated. It was found that the denudation of extensive areas had become an accomplished fact, and that more were rapidly following in the same path. The principal causes were, as in all similar cases, the following:—

(1) Reckless working of the forests by natives and colonists.

(2) Extensive and frequent fires overrunning the forests, destroying all humus, seedlings, and young trees, and damaging more or less the trees of more advanced age.

(3) Uncontrolled clearing of land for cultivation.

So much having been ascertained, the Government should at once have proceeded to take steps to counteract the evil; but only half-measures were adopted. The Government attempted to bring the forests under control by prohibiting certain acts, without providing an efficient agency to see the restrictions enforced. If in any instance they were enforced, it was found that they interfered with previously prevailing practices, complaints were made, and the strife swayed to and fro. Then the Government of the time tried various means to satisfy all parties. Once it resolved to throw the forests open to private enterprise by offering them for sale. In this manner a certain area passed into the hands of private parties, but fortunately only a limited number of lots were sold. Next, the forests were closed, but this also would not meet the case, and they were opened again, so-called licenses for the removal of fixed quantities of material being issued against small payments. There being no proper staff to control the operations, matters grew from bad to worse. About this time Dr. Brown appeared upon the scene, having accepted the appointment of Government Botanist of the Cape Colony in the year 1863. He soon perceived the unsatisfactory condition of the Cape woodlands, and he strongly urged the introduction of a more systematic treatment. Fresh inquiries were set on foot, new Committees sat and deliberated, but it was not until the year 1881 that really efficient measures were adopted. By that time the mischief had been done, and the yield of the forests was so low that, out of a total consumption of two and a quarter million cubic feet of timber, only a quarter of a million cubic feet came from the colonial forests, while a little over two million cubic feet were imported.

In the year 1881 the services of a French forest officer, Count de Vasselot de Regne, who had previously done excellent service in the fixing of the dunes and creation of extensive new forests at Royan, near Bordeaux, were secured as Superintendent of the Cape forests, and with his advent a new *régime* commenced. The selection of this gentleman, due, we believe, to Colonel Pearson, lately in charge of the English forest students at Nancy, was most fortunate. Although we are not acquainted with the Cape from personal experience, we have no hesitation in saying that the reports issued during the last six years prove the administration of the Cape forests to rest in very able hands, and that substantial progress has been made during that short period towards placing the management on a sound and solid basis. A fairly adequate and competent staff has been brought together, the forests are being demarcated, waste is being put down, fir conservancy has been begun, blank areas are being planted, and there is altogether a fair prospect that, after

some time, the colony will once more be in a position to supply the necessary forest produce from its own woodlands. At the same time the financial aspect of the business has not been overlooked, and there are indications that the woodlands will before long prove to be a source of substantial income to the colonial Exchequer.

The forests of the Cape deserve to be carefully preserved, not only for the purpose of their direct utility in providing timber and other produce, but also for their usefulness in other respects. Whether their existence will increase the rainfall to any appreciable extent may be a matter of doubt, but they certainly moderate the temperature and reduce evaporation; in other words, they husband the water which falls on the soil. This effect is all the more important, because Cape Colony is situated, approximately, between the 28th and 35th degrees of south latitude, and the rainfall over about half the area amounts to less than 10 inches a year, while only a comparatively small portion enjoys a rainfall of over 20 inches.

Considering these matters, we trust that the colonial authorities will now persevere in making up for past remissness by maintaining steadily a policy of efficient forest conservancy. It needed many warnings before the proper steps were taken, and in this respect no one deserves more praise than Dr. Brown. By raising his voice loudly during the years 1863-66 he has certainly deserved well of the Cape Colony. While it is a pleasure to record this, it is to be regretted that our author has not succeeded in placing the history of the case before the public in a more readable form than that adopted in the present volume.

SW.

OUR BOOK SHELF.

Thomas A. Edison and Samuel F. B. Morse. By Van Buren Denslow, LL.D., and Jane Marsh Parker. (London: Cassell and Co., 1887.)

THIS book is an evident compilation, principally of newspaper cuttings from the other side of the Atlantic. The authors are Americans. Edison is posed as the inventor of the duplex and quadruplex systems of telegraphy, though each was invented in Europe when he was seven years old; while Morse is lauded as having sent the first telegram in 1844, when telegraphy was seven years old, and flourishing well in England. Edison's grandfather lived to be 102 years old, his father is now living at 83. It is to be hoped that he will live long enough to tire out these foolish defamers of his true merit, for merit, industry, and inventive skill he certainly has. Personally he is a charming man, and impresses one with his modesty and communicativeness. The phonograph, carbon transmitter, and glow lamp are quite sufficient to establish his fame without dragging in apparatus he simply altered or perhaps improved. We read in this silly book, "The very words 'electric light,' must stand for ever as closely associated with the name of Edison as is gravitation with Newton or the telescope with Galileo."

We read (p. 96):—"There have been four eras in the history of the magnetic telegraph. In each of these eras a citizen of the United States has been conspicuous. . . . The first era was that of Franklin and his kite. . . . The second era was that of invention—the era of Morse, Henry House (*sic*), and *Daniell* [so the authors reckon Daniell an American!]. Had the Daniell battery been known in 1827, one Harrison Gray Dyer, of New York, would have given to the world what Prof. Morse did not complete until some seventeen years after.

"The third era was that of the evolution of the telegraph—the multiplication of its effects. Of the many names conspicuous in this era none are more deserving of special mention than Hiram Sibley, and none take precedence of Thomas Alva Edison." [N.B.—Edison was born in 1847.] The fourth era was "an era of chaos in its beginning, when Morse lines, Bain lines, House lines, and O'Reilly lines, with their endless litigations over infringements of patents and broken contracts, local jealousies, disastrous competitions, unequal and capricious tariffs, made investing in telegraph stocks a sure method of throwing away money."

And this is history!

The following story is gravely told:—

"When the boy (Edison) was a little under six years old, he became greatly interested in the fidelity with which an old goose was brooding her nest of eggs. When the young family of golden-green goslings came out and took to the water, he was told that this astounding result was produced simply by the animal heat of the old bird sitting on them. The first lesson in organic chemistry was of a kind too remarkable to be let slip without testing it by experiment. Soon after the boy was missed. Messengers were sent after him everywhere, but he could not be found. 'By and by,' says the sister, 'don't you think father found him curled up in a nest he had made in the barn, sitting on goose eggs and hen eggs and trying to hatch them?'"

Sound, Light, and Heat. By Mark R. Wright. (London: Longmans, Green, and Co., 1887.)

WE gladly welcome the appearance of such an admirable text-book as the one before us. It embraces the work required for the various elementary examinations in sound, light, and heat, but it is in no sense a cram-book. The subjects are treated experimentally, and the arrangement is apparently that which practical experience in teaching has led the author to believe to be the best. The experiments described are thoroughly practical, but, at the same time, the apparatus required is comparatively simple. The author is of opinion—and we quite agree with him—that a beginner's time is best spent in making himself acquainted with the facts of science; he has accordingly given little space to theoretical considerations, but he has carefully avoided making statements that might lead the student to form notions at variance with the modern theories.

The drawings, and the descriptions of the apparatus they represent, leave nothing to be desired. The numerical examples, of which there is a great number, combined with the experimental treatment, entitle the book to rank as one of our best text-books of elementary science, and we can confidently recommend it.

Through the West Indies. By Mrs. Granville Layard. (London: Sampson Low, 1887.)

THE author of this little book spent several months in the West Indies, and heartily enjoyed her expedition. She has nothing very new to say about the various places she visited, but she writes pleasantly, and succeeds in conveying a vivid impression of many of the scenes by which she herself was strongly impressed. Occasionally she offers shrewd suggestions as to the industry and trade of the West Indian Islands, and she gives as an appendix a useful paper on "The Sugar Question." This paper contains the substance of notes and suggestions furnished by the Hon. W. H. Ioner, Member of the Legislative Council, Barbados.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.*

"The Conspiracy of Silence."

WILL you allow me a word on "The Great Lesson" by the Duke of Argyll? It is especially what is said about Darwin's coral-island theory in the following lines, to which I wish to refer:—"All the acclamations with which it was received were as the shouts of an ignorant mob. It is well to know that the *plébiscites* of science may be as dangerous and as hollow as those of politics. The overthrow of Darwin's speculation is only beginning to be known. . . . Reluctantly, almost sulkily, and with a grudging silence as far as public discussion is concerned, the ugly possibility has been contemplated as too disagreeable to be much talked about."

The terms "ignorant mob," "sulkily," and "grudging silence," as used above, cannot readily be forgotten if forgiven by men of science on this side of the Atlantic any more than by their brethren in England.

I am unable to see anything sulky or silent in the exposition of Mr. Murray's coral-island theory of over three pages in length, which was published and sent to all the scientific world in NATURE, vol. xxii. p. 351; nor in the many articles in the current literature and recent geological text-books that have since appeared. In this country no large text-book of geology has been issued since 1880; but Mr. John Murray's work has been fairly discussed, and, so far as I know, has always been recognized. Here at Williams College, for example, the views of Mr. Murray referred to have been expounded each year in the course in geology since 1880. One may, I take it, differ from the Duke of Argyll in accepting or rejecting, wholly or in part, any theory, without laying himself open to the charges quoted above. Of anything like sulkiness or grudging silence I have yet to see or hear the first evidence. There is indeed a "great lesson" in the article by the Duke of Argyll, but it is hardly the one he intended to give. SAMUEL F. CLARKE.

Williams College, Williamstown, Mass., December 5.

"DARWIN'S LIFE AND LETTERS" are now public property, and as reference to vol. iii. p. 242, shows—what nearly every scientific man knew—that the late Sir Wyville Thomson was distinctly anti-Darwinian in his views, it follows that the Duke of Argyll's inferences as to his reasons for urging Mr. Murray's withdrawal of the "new coral-reef theory" paper from the Royal Society of Edinburgh is illogical, not to say absurd. In justice to Sir Wyville's memory and in support of Mr. Bonney's surmise (NATURE, November 24, p. 77) I wish to state that, talking with Sir Wyville about "Murray's new theory," I asked what objection he had to its being brought before the public? The answer simply was: he considered that the grounds of the theory had not as yet been sufficiently investigated or sufficiently corroborated, and that therefore any immature, dogmatic publication of it would do less than little service either to science or to the author of the paper.

AN OLD PUPIL OF WYVILLE THOMSON'S.

December 17.

Greenland Glaciers.

I HAVE received a letter from Prof. Steenstrup, of Copenhagen, which gives further interesting information respecting the extraordinarily rapid advance of the Greenland glaciers, and corroborates the opinion I expressed in the paper I recently read before the Geological Society, that the rate of advance during the Glacial period may have been far more rapid than that generally assumed, and that that period should be much shortened. Prof. Steenstrup states:—

"Meantime the difference between the Alpine data and the Greenland data seems to have grown greater and greater. During the now returned biennial expedition to our northernmost boundary of the west coast of Greenland, the leader of the Expedition, the clever naval officer, Mr. Care Ryder, has measured a progress or a flow of the great glaciers = 99 feet per diem or in twenty-four hours during the summer, and = 30–35 feet in twenty-four hours during winter months."

This, no doubt, will interest many of your Alpine readers.

JOSEPH PRESTWICH.

Shoreham, Sevenoaks, December 17.

"The Mammoth and the Flood."

IN the notice which you have given of my book, which you are good enough to say is, apart from its theories, a valuable work of reference, I should have been more gratified if you had devoted a little space either to stating my arguments or to refuting them, instead of indulging in a rhetorical wail over my backsliding from the orthodox ways of uniformity.

The theories for which I am responsible have been accepted by so many men in the first rank in science in both hemispheres that I am naturally anxious to have them seriously and severely discussed, and I think your critic would allow that I have justified my hope that this will be the case by converging upon my inferences an unusual array of facts.

It was assuredly quite time that someone who disbelieves in "authority in science" should raise a strong protest against the extravagant position which the English school of geology has taken up on this question of uniformity, an extravagance of which students in other branches of science are hardly aware.

The head of the Geological Survey in this country, speaking not long ago with all the authority and responsibility which surround a President of the British Association, committed himself to the following statement:—"From the Laurentian epoch down to the present day, all the physical events in the history of the earth *have varied neither in kind nor in intensity from those of which we now have experience.*"

This was not the opinion of an irresponsible and eccentric student, but of the official mouthpiece of English geology, and with one notable exception—namely, Prof. Prestwich—it has remained, so far as I know, without protest or repudiation, while Prof. Prestwich himself has been treated as a heretic for the views he has so courageously and ably maintained.

My book is meant to challenge the doctrine of uniformity as generally held by English geologists, and which as held here is largely repudiated both in America and on the Continent.

In regard to its many arguments, I cannot defend them in a letter, but I can shortly examine the only one to which your critic directs attention, and which happens to be a very crucial one.

This is the explanation of the existence of a series of mammoths buried in the tundras of Siberia, throughout its entire length, with their soft parts intact. This fact, which has been known for a century, compelled Cuvier long ago to adopt a conclusion which I have simply accepted and enlarged. I state it shortly in the following extract from my work:—"The facts compel us to admit that when the mammoth was buried in Siberia the ground was soft and the climate genial, and that immediately afterwards the same ground became frozen, and the same climate became Arctic, and that they have remained so to this day, and this not gradually and in accordance with some slowly continuous astronomical or cosmical changes, but suddenly and *per saltum*." I also argue that the only way I can explain the existence of a chain of such carcasses buried many feet deep in *continuous beds of gravel and clay* is by the operation of one cause only, and that a flood of water on a large scale.

Your critic, who I can hardly think has read the part of my book dealing with this issue, says that the carcasses are found in ice. The fact is, *they are never found in ice*, as the Russian explorers have so well shown. The reference to ice in the account of the discovery of the famous Adam's mammoth has been shown by Baer to have been altogether misunderstood, and nothing is more clear than that they are found buried deep in hard frozen gravel and clay.

Secondly, he urges a view which was generally held fifty years ago, but which has been completely dissipated by the elaborate researches of the Russian naturalists, especially the geologist Schmidt, and which I quote at length—namely, that the carcasses have in some way been floated down by the Siberian rivers and buried in their warp. As Schmidt shows, the

Siberian rivers make no deposit, either in winter or summer, which could cover in a mammoth. Nor are the mammoths chiefly found near rivers, but on high ground out of the reach of rivers. When they occur near the rivers, it is generally on the head streams, which could not float such carcasses.

Surely, in criticizing my view of a problem which has been the crux of almost every serious student since the days of Cuvier, your critic might have noticed these now elementary facts. It is not fair to me or to your readers to deal with this difficult question as if it could be settled by a casual reference to causes long ago discarded by such authorities as Brandt and Baer, Schmidt and Schrenck.

I am anxious beyond measure to meet with some criticism that I can reply to, and shall not shrink from the issue being tried by the severest tests.

What I complain of, and others more important than myself share my opinion, is that the only answer forthcoming from uniformitarians to test cases like the one above referred to is, ostrich-like, to put their heads in the sand and to cry out, "Since we are committed to Lyell's theory, it is useless to quote facts against us." This may have done in the fifteenth century, but it will not do now when so many critics are abroad.

May I presume to invite a discussion in your paper on this most interesting question? I cannot forget that it was in your pages I first raised it many years ago.

Bentcliffe, Eccles, December 10. HENRY H. HOWORTH.

IN regard to the first part of Mr. Howorth's letter, I must remind him that it was admitted in my review that such a being as an irrational uniformitarian did exist, and was duly smitten in his book.

In regard to the occurrence of mammoth carcasses (not skeletons), I wrote of ice with some hesitation, knowing alleged cases to be open to question, but I mentioned it, because, in my opinion, it would be the most difficult to explain, and the strongest case in favour of Mr. Howorth. Where the carcass is preserved in clay or gravel the difficulty is less. All that seems needed is a flood of rather exceptional character, carrying the dead beast rather far north; then, if this happened at the right season of the year, the body might be buried by other floods before decomposition set in (the temperatures might be always low, though sometimes above 32° F.), and so the body might escape unrotted, until it was finally well entombed. My position was that, though this explanation of the escape of a carcass from destruction, under circumstances not very different from the present, was not easy, the explanation of such a series of catastrophes as Mr. Howorth demanded was much harder. The grounds of this opinion cannot of course be stated in the limits of a letter, nor can I discuss *seriatim* the cases which he cites. So far as my memory serves me (I am writing at a distance from any scientific library) they are not so universally favourable to his view as is stated in his letter.

The remainder of Mr. Howorth's letter is open to the charge which he brings against the review, of being merely rhetorical. *Quis tulerit Gracchos de seditione querentes?*

YOUR REVIEWER.

Centre of Water Pressure.

THE following extremely simple construction for the centre of pressure of a homogeneous liquid on a triangular area occupying any position whatever in the liquid has not (I learn from a high authority on hydrodynamics) been hitherto known, and it may be interesting to some of the readers of NATURE.

Let a particle be imagined to be placed at each vertex of the triangle, its mass being proportional to the depth of this vertex from the surface of the liquid; let G' be the centre of gravity of these particles, and let G be the "centre of gravity" of the triangular area. Then P, the centre of pressure, lies on the line GG' at a distance $\frac{1}{4}GG'$ from G.

There is another almost equally simple way of expressing this result; and of course it is known that there are other ways, more or less practically unmanageable, of representing the position of this point, P, by means of momental ellipses, &c.

GEORGE M. MINCHIN.

R.I.E. College, Cooper's Hill, December 15.

The Recent Earthquakes in Iceland.

ON October 28 last, at 20 minutes past 5 in the morning, two earthquakes occurred at Reykjavík, and reports were soon received as to earthquakes in other districts, especially at Cape Reykjanes. The whole peninsula of Reykjanes is covered with lava streams, and there are many craters and fissures. The extreme point of this peninsula seems in former times to have been the scene of many volcanic eruptions. Tradition tells that long ago the promontory stretched eight miles further to south-west than it does now, and that great earthquakes and volcanic eruptions in the years 1389–90 produced the subsidence of the ancient promontory. The land reached then to Eldey (the Fire Island), or, as the Danes call it, "Melsækken." In historic times ten volcanic eruptions are known to have taken place in the neighbourhood of these rocks.

During the night between October 27 and 28 more than forty shocks were felt at the lighthouse of Cape Reykjanes, nine of the lamps were broken, and the house where the lighthouse keeper lives and a warehouse were damaged. A fissure from south-west to north-east was formed in the rocks 2 yards from the lighthouse; the rocks beneath were cracked in several places, and these cracks go in the same direction as the old fissures associated with volcanic cones. At Eyrarbakki the earthquake was observed at 25 minutes past 5, and proceeded from north-north-west to south-south-east. To north-west the earthquake was felt in Borgar fjord, and as far to the south-east as to Eyjafjöll. This shock was therefore felt over an area of more than 4500 square miles.

A less violent earthquake was felt here in Reykjavík on November 13, at 35 minutes past 9 p.m.

In the year 1882 I published in an Icelandic review, *Andvari*, a list of questions concerning earthquakes, nearly the same as were published in 1880 by Prof. A. Heim for the Earthquake Commission in Switzerland. A similar list of questions has now been printed in the Icelandic newspapers. The questions will also be printed separately, and sent to Icelandic clergymen and others who probably take interest in this subject.

Reykjavík, November 30. TH. THORODDSEN.

The Canary Islands.

NOW that the Canary Islands are rapidly becoming better known as one of the most advantageous health-resorts within easy reach of England, it may be of some interest to mention a few facts concerning diseases in the Archipelago.

The one pre-eminent fact is that the climate seems to modify the virulence of the worst, the most dangerous diseases. Puerperal fever, though rather prevalent, is seldom, I may almost say never, fatal, though I know of cases where the patient has been neglected for several days before medical advice was obtained. Diphtheria is also very prevalent in the large towns, owing to the total absence of the most ordinary sanitary precautions, but it seems always to exist in a mild form. I know of certain families who apparently have it frequently, but this terrible disease seems to be only fatal where the most elementary knowledge of nursing is absent.

Fevers of all kinds are lighter in character. The treatment recommended there by the profession is different from that in vogue in England. For example, it starts by a thorough clearing out of the system by means of somewhat violent purgatives and emetics.

Equable as is the climate by day and night, the natives suffer most from chills, which often end fatally. This, I think, may be in a great measure accounted for by the absence of woollen or silken clothing. Those who visit the Canaries from colder northern latitudes where wool is worn next the skin, and who most wisely continue this habit, do not suffer in this way. It is advisable that every article of clothing worn in the islands be either made of wool or silk. Thus armed, one is almost impregnable to the attacks of any disease of a catarrhal nature. Malaria does not exist. Precautions as to hours of recreation, such as keeping in the house at sundown, are in these islands unnecessary, and one may be out on the hottest day at the hottest hour without fear of sunstroke.

The only disease which in any way can be said to be peculiar to, or prevalent in, the Canary Islands is elephantiasis, which, as your readers well know, does not affect well-nourished inhabitants, and is neither contagious nor infectious.

In Gran Canaria diseases of the stomach and intestines are

common among the peasants. Such are clearly traceable to the national food, *gofio*, which in this island is made of Indian corn.

For phthisis the Canary Islands have been proved of inestimable value, and therefore on this point nothing more need be said. The temperature throughout the year, by day and by night, varies exceedingly little. In my recently-published work on these islands I have gone so fully into this question that I need not recapitulate it here.

I should not have thus ventured to trouble you had I not been asked by some leading members of the medical profession to summarize the facts, bearing upon diseases, scattered through the pages of my book and to add thereto others which I had deemed unsuitable for the general reader. OLIVIA M. STONE.

11 Sheffield Gardens, Kensington, W., December 14.

The Ffynnon Beuno and Cae Gwyn Caves.

MR. SMITH has entirely failed to substantiate the statement made by him in his letter of December 1 (p. 105) concerning the drift over the entrance of the Cae Gwyn Cave, which is 20 feet in thickness and full of ice-scratched boulders, many of large size; therefore I need only say in reply that the Geological Surveyors who surveyed this district have examined the section and have had no hesitation whatever in classifying the deposits in the section with the Glacial beds of the area. In regard to the age of river-drift implements as compared with those found in the cavern, which are identical with the implements found in Kent's cavern and the French caves, I need only quote the remarks of M. Lartet ("Reliquiæ Aquitanicæ," p. 9):—"If some are inclined to attribute to the works of human industry found in the 'Diluvium' or 'Drift' a date more ancient than to those occurring in caves with a similar association of animal remains, we are obliged to remark that such a proposition, expressed as a systematic generalization, is not justifiable in any point of view." . . . "Caves were in truth the first shelter which primitive man would choose, whether driven by instinct or determined by reason."

When Mr. Smith calls the implements found in the gravels at Mildenhall, Neolithic, which others claim to be Palæolithic, and one most eminent authority to be pre-Glacial, I am perfectly justified in saying that the classification of such implements, as defined by Mr. Smith, has no chronological value, and therefore I do not think that anyone is likely to be convinced by his arguments when he is "content to resist the idea of the pre-Glacial age of these caves on purely archæological grounds."

HENRY HICKS.

Hendon, December 23.

Distorted Earth Shadows in Eclipses.

WITH reference to the peculiar appearance of the earth's shadow in the lunar eclipse of August 3 of this year, and noted by "H. H." and "M. C." (see NATURE, vol. xxxvi. pp. 367 and 413), it may be of interest to record a similar distortion observed by Capt. A. E. Barlow, on the s.s. *Nizam*, at Suez, on August 23, 1877. The following entry appears in his meteorological log:—

"The eclipse of August 23. The moon as seen at midnight at Suez. Weather fine starlight. A few cir.-c. (amount 3) travelling from northward."

The shadow was irregular and jagged as in "M.C.'s" description. HENRY TOYNBEE,
Marine Superintendent.

Meteorological Office, December 22.

DR. BALFOUR STEWART, F.R.S.

IN the genial Manchester Professor the scientific world has lost not only an excellent teacher of physics but one of its ablest and most original investigators. He was trained according to the best methods of the last generation of experimentalists, in which scrupulous accuracy was constantly associated with genuine scientific honesty. Men such as he was are never numerous; but they are the true leaders of scientific progress:—*directly*, by their own contributions; *indirectly*, though (with rare exceptions) even more substantially, by handing on to their students the choicest traditions of a past age, mellowed by time and enriched from the experience of the present. The name of Stewart will long be remembered for more than one striking addition to our knowledge, but his patient and reverent spirit will continue to impress for good the minds and the work of all who have come under its influence.

He was born in Edinburgh, on November 1, 1828, so that he had entered his sixtieth year. He studied for a short time in each of the Universities of St. Andrews and Edinburgh, and began practical life in a mercantile office. In the course of a business voyage to Australia his particular taste for physical science developed itself, and his first published papers:—"On the adaptation of the eye to different rays," and "On the influence of gravity on the physical condition of the Moon's surface":—appeared in the *Transactions of the Physical Society of Victoria* in 1855. On his return he gave up business for science, and resumed study under Kelland and Forbes, to the latter of whom he soon became Assistant. In this capacity he had much to do with the teaching of Natural Philosophy on occasions when Forbes was temporarily disabled by his broken health. During this period, in 1858, Stewart was led to his well-known extension of Prévost's *Law of Exchanges*, a most remarkable and important contribution to the theory of Radiation. He seems to have been the first even to suggest, from a scientific stand-point, that radiation is not a mere surface phenomenon. With the aid of Forbes' apparatus, then perhaps unequalled in any British University, he fully demonstrated the truth of the conclusions to which he had been led by theory; and the award of the Rumford Medal by the Royal Society, some years later, showed that his work had been estimated at its true value, at least in the scientific world. In fact his proof of the necessary equality between the radiating and the absorbing powers of every substance (when divested of some of the unnecessary excrescences which often mask the real merit of the earlier writings of a young author) remains to this day the simplest, and therefore the most convincing, that has yet been given.

Radiant Heat was, justly, one of Professor Forbes' pet subjects, and was therefore brought very prominently before his Assistant. Another was Meteorology, and to this Stewart devoted himself with such enthusiasm and success that in 1859 he was appointed Director of the Kew Observatory. How, for eleven years, he there maintained and improved upon the memorable labours of Ronalds and Welsh needs only to be mentioned here:—it will be found in detail in the *Reports of the British Association*. Every species of inquiry which had to be carried out at Kew:—whether it consisted in the testing of Thermometers, Sextants, Pendulums, Aneroids, or Dipping-Needles, the recording of Atmospheric Electricity, the determination of the Freezing-Point of Mercury or the Melting-Point of Paraffin, or the careful study of the peculiarities of the Air-Thermometer:—received the benefit of his valuable suggestions and was carried out with his scrupulous accuracy.

About twenty years ago Stewart met with a frightful railway accident, from the effects of which he did not fully recover. He was permanently lamed, and sustained severe injury to his constitution. From the vigorous activity of the prime of life he passed, in a few months, to grey-headed old age. But his characteristic patience was unruffled, and his intellect unimpaired.

His career as Professor of Physics in the Owens College has been, since his appointment in 1870, brilliantly successful. It has led to the production of an excellent treatise on *Practical Physics*, in which every necessary detail is given with masterly precision, and which contains (what is even more valuable, and could only have been secured to the world by such a publication) the matured convictions of a thorough experimenter as to

the choice of methods for the attack of each special Problem.

His *Elementary Physics*, and his *Conservation of Energy*, are popular works on physics rather than scientific treatises:—but his *Treatise on Heat* is one of the best in any language, a thoroughly scientific work, specially characteristic of the bent of mind of its Author.

Stewart published, in addition to his *Kew Reports*, a very large number of scientific memoirs and short papers. Many of these (notably the article in the *Encyc. Brit.*, 9th edn.) deal with Terrestrial Magnetism, in itself as well as in its relations to the Aurora and to solar disturbances. A valuable series of papers, partly his own partly written in conjunction with De la Rue and Lœwy, deals with Solar Physics. His paper on the *Occurrence of Flint Implements in the Drift* (*Phil. Mag.* 1862, I.) seems to have been ignored by the "advanced" geologists, one of whose pet theories it tends to dethrone; and to have been noticed only by physicists, especially Sir W. Thomson, whose beautiful experiments have done so much to confirm it. His paper on *Internal Radiation in Uniaxal Crystals*, to which Stokes alone seems to have paid any attention, shows what Stewart might have done in Mathematical Physics, had he further developed the genuine mathematical power which he exhibited while a student of Kelland's.

I made Stewart's acquaintance in 1861, when he was the first-appointed Additional Examiner in Mathematics in the University of Edinburgh, a post which he filled with great distinction for five years. A number of tentative investigations ultimately based upon our ideas as to possible viscosity of the luminiferous medium, effect of gravitation-potential on the physical properties of matter, &c., led to the publication of papers on *Rotation of a disc in vacuo*, *Observations with a rigid spectroscope*, *Solar spots and planetary configurations*, &c. These, as well as our joint work called *The Unseen Universe*, have been very differently estimated by different classes of critics. Of course I cannot myself discuss their value. There is, however, one of these speculations, so closely connected with Stewart's Radiation work as to require particular mention, especially as it seems not yet to have received proper consideration, viz. *Equilibrium of Temperature in an enclosure containing matter in visible motion.* (NATURE, 1871; iv. 331.) The speculations are all of a somewhat transcendental character, and therefore very hard to reduce to forms in which they can be experimentally tested; but there can be no doubt that Stewart had the full conviction that there is in them all an underlying reality, the discovery of whose exact nature would at once largely increase our knowledge.

Of the man himself I cannot trust myself to speak. What I *could* say will easily be divined by those who knew him intimately; and to those who did not know him I am unwilling to speak in terms which, to them, would certainly appear exaggerated.

P. G. TAIT.

CHRISTMAS ISLAND.

PROFESSOR NEWTON sends us the following extracts from a letter received by him from Mr. J. J. Lister, M.A., St. John's College, Cambridge, the naturalist on board H.M.S. *Egeria*, Commander Aldrich, R.N., describing the recent visit to that little-known island:—

"We left Batavia on Tuesday, September 27, about 5 a.m., and were in the Straits of Sunda by the afternoon. We saw the hills on the Java side clearly, scored by many steep-sided valleys, and the green of the fields contrasting brightly with the red volcanic earth. Behind these nearer hills one of the great conical mountains loomed out every now and then from his covering of clouds. To the westward, and more distant, a high volcanic peak on the main island of Sumatra rose above nearer islands, and later in the afternoon we saw the simple conical mass of Krakatão. Next day we were bouncing about in deep blue water, as we steamed south against a head-wind—a change after the quiet sailing over the pale green shallow seas in which we had been since we entered the Straits of Malacca. On Friday, September 30, we reached Christmas Island. The first we saw of it was a long line against the south-east horizon, with a shallow saddle in the middle and a gradual rise at either end—that to the west being the higher. On nearer approach the island was seen to be uniformly covered with trees, with a low cliff, much undermined at the water's edge; above this a gradual slope leads to another steep ascent, which in some places, especially at the projecting headlands, is a bare cliff, in others covered with trees. From this there is a gradual rise to the top. We found that there is a cap of coral limestone over the whole island. The top is formed of gray pinnacled masses with steep fissures between them, and the surface of the rock is worn into a rough honey-comb with sharp points and ridges which break under foot and show the glistening white rock. On the slope of the island this rock forms horizontal terraces, with a rough slope of pinnacled masses or a sheer cliff leading down from them, and these seemed to be in a general way continuous at the same level along the side of the island. I suppose they mark the pauses in its gradual elevation during which a fringing reef has formed. Some pieces of rock, apparently volcanic, were picked up at Flying-fish Cove, but it was not found where they had fallen from.

"No stream or standing water was found. Apparently all the rain that falls soaks into the porous rock at once. The vegetation, however, looked fresh and green, and the under parts of fallen logs were sodden with moisture. On two of the nights during the ten days we were there, there was heavy rain; otherwise we had fine weather. Many of the trees are tall, reaching 150 to 170 feet or more, and some of them have vertical buttresses at the base, which wind about horizontally and give off secondary buttresses. They are often laden with great clumps of birds'-nest ferns, as well as with other ferns, orchids, and parasitical trees, and their trunks are festooned with long straight lianas. I only found two orchids with flowers out, but these were small and inconspicuous. Along the shore there are tangled thickets of screw pines, and another kind grows on the higher part. A large proportion of the trees bear edible fruits. Altogether I am sending home some fifty kinds of flowering plants and fifteen of ferns.

"The rat (*Mus macleari*) swarms on the island. They come out at dusk, and run about, in and out of the tents that were pitched by the shore, through the night. There is another kind of rat which is larger and black, except where the scanty fur on the feet allows the pale skin to show. There is also a shrew mouse, whose short shrill squeak may often be heard in the woods. I caught three of them one night in a pitfall. Several specimens of the fruit-eating bat (*Pteropus natalis*) were obtained, including males, which have no pale-coloured tippet, as Mr. Thomas [P.Z.S., 1887, p. 512] thought might possibly be the case. There is a small insectivorous bat in the island, but I did not succeed in getting one.

"The large fruit-eating pigeon (*Carpophaga whartoni*) is very common. They congregate in the fruit-bearing trees, and may then be shot by the dozen. They are excellent eating, and supplied fresh meat for the ship.

"There is a small dove—brown, with a rich bronzy-green on the back and wings—which is very common. Their habits are remarkably in keeping with their colouring. On trees they are restless and seldom seen, but on the ground, among fallen brown and green leaves, where their colour makes them very inconspicuous, they seem to have no fear. I shot seven one morning close to our place: they were feeding in pairs on fallen berries, and

when one of a pair was shot, the other went on feeding as though nothing had happened.

"The thrush (*Turdus erythropleurus*) is very abundant, and as tame as possible. None of my specimens show any mottling, but Capt. Aldrich told me that he saw one with the breast mottled. The bill and feet are as yellow as a cock blackbird's. I heard no *song*, but they often give a 'chick——chick——chick—chick-chick-chick,' quickening time at the finish.

"Parties of twelve to twenty of a species of *Zosterops* were very common. They had just-fledged young ones among them.

"The other birds we obtained were two hawks, an owl, a swift, a heron, a plover, and a sandpiper. Besides these, frigate-birds, gannets, boobies, and boatswain-birds of two kinds were everywhere abundant.

"We obtained three kinds of lizards, and the *Typhlops* which was found before, but no tortoises. We saw a turtle making off down the beach early one morning, but it got into the sea before it could be turned over.

"We saw no frogs, and heard none.

"We found five kinds of land-shells, four of butterflies, a few moths, and some eighteen species of beetles, besides spiders, centipedes, &c. I have one of the hawks alive, which I hope to be able to bring home to England. . . . . "J. J. LISTER."

Accounts have been received from Captain Aldrich, R.N., of H.M. surveying-vessel *Egeria*, of a recent visit to Christmas Island in the Indian Ocean, made in consequence of the interest attaching to the small collection recently brought thence by Captain Maclear, R.N., (see NATURE, vol. xxxvi. p. 12). Mr. J. J. Lister kindly volunteered to act as naturalist, and proceeded from England to Colombo, whence he took a passage in the *Egeria* for the purpose of collecting.

Captain Aldrich states that the highest point of the island was reached at the expense of considerable labour, but without as much difficulty as was anticipated. This point is 1200 feet high, and not, as was before incorrectly stated, 1580 feet.

The island is coral-clad to the very top, the actual summit being a block of coralline limestone, worn and undermined. No rock other than of a calcareous nature was met with in the island, though a diligent search was made, and holes dug where the soil appeared thickest.

Three tiers of cliffs, probably marking sea-levels, intervene between the top of the existing sea cliffs and the summit. Breaches in these cliffs afforded means of scaling them, aided by the numerous aërial roots of the trees with which the island is densely covered.

Between the cliffs the ground rises irregularly, being covered in some places with soil apparently deep, intermixed with fragments of coral. Tangled jungle and high forest grow everywhere. The vertical rise to the summit where ascended takes place in the following manner, as described by Captain Aldrich :—

Coast cliff	30	feet vertical.
Moderate slope	90	,,
First inland cliff	85	,,
Moderate slope	250	,,
Second inland cliff / Slope / Third inland cliff	95	,,
Steep slope of rough ground	650	,,

The total horizontal distance is about 5000 feet.

Christmas Island therefore appears to be a remarkable instance of the complete casing with coral of an island which, from the time that its nucleus first came within the reef-building zone, has been steadily subjected to a movement of upheaval, varied by pauses, during which the cliffs were eroded by the sea. So far as I am aware, no case of similar magnitude has yet been recorded.

The collections now on their way to England are, it is feared, not so varied as was anticipated from the samples of life brought home by the *Flying Fish*.

A considerable number of interesting photographs were obtained by the officers, and accompany Captain Aldrich's report, which will be published.

The *Egeria* has obtained a line of soundings across the hitherto unfathomed area of the southern Indian Ocean, between the Strait of Sunda and Mauritius, but no details have as yet come to hand.

December 17. W. J. L. WHARTON.

TIMBER, AND SOME OF ITS DISEASES.[1]

II.

THE enormous variety presented by the hundreds of different kinds of woods known or used in different countries depends for the most part on such peculiarities as I have referred to above, together with some others which have not as yet been touched upon. Everybody knows something of the multitudinous uses to which timber is put, and a little reflection will show that these uses are dependent upon certain general properties of the timber. Speaking broadly, the chief properties are its weight, hardness, elasticity, cohesion, and power of resisting strains, &c., in various directions, its durability in air and in water, and so forth; moreover, special uses demand special properties of other kinds also, and the colour, closeness of texture, capacity for receiving polish, &c., come into consideration.

Now, there is no doubt that the structure of the wood as formed by the cambium is the chief factor in deciding these technological characters: it is not the only factor, but it is the most important one. Consequently no surprise can be felt that those who are interested in timber have of late years turned their attention to this subject with a view to ascertain as much as possible about this structure, and to see whether it can be controlled or modified, what dangers it is subject to, and how far a classification of timbers can be arrived at. The more the subject is studied, the more interesting and practically important the matter becomes. The results already obtained (though the study is as yet only in its infancy), have thrown brilliant light on several burning questions of physiology—as witness the researches of Sachs, Hartig, Elfving, and Godlewski, on that old puzzle, to account for the ascent of water in tall trees. The study is, moreover, of first importance for the comprehension of the destruction of timber, due to "dry-rot" and the parasites which cause diseases in standing trees, as is shown by the brilliant researches of Prof. R. Hartig on the destruction of timber by Hymenomycetes; and again as yielding trustworthy information as to the value of different kinds of timber in the arts, and enabling us to recognize foreign or new woods of value. In support of this statement it is only necessary to call attention to the "Manual of Indian Timbers," prepared for the Indian Government by Mr. Gamble; or to refer to the beautiful series of wood-sections prepared by Nördlinger.

It is, of course, impossible in an article like the present to do more than touch upon a few of the more interesting points in this connection; but I may shortly summarize one or two of the more striking of these peculiarities of timbers, if only to show how well worth further investigation the matter is.

Many timbers, from both tropical and temperate climates, exhibit the so-called "annual rings" on the transverse section; but this is not the case with all. Most European timbers, for instance, are clearly composed of such layers; but in some cases the layers ("rings" on the transverse section) are so narrow and

[1] Continued from p. 186.

numerous that the unaided eye can scarcely distinguish them, or the differences between the spring and autumn wood are so indistinctly marked that they may appear to be absent, or are at least obscure, as in the Olive, Holly, and Orange, for instance. It is in the tropics, however, that timber without annual rings is most common, chiefly because the seasons of growth are not sufficiently separated by periods of rest to cause the

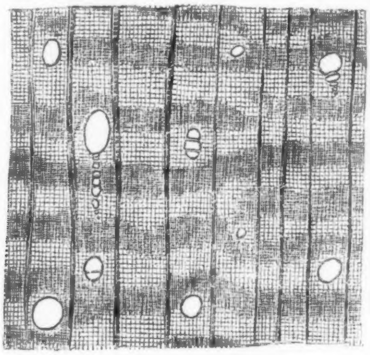
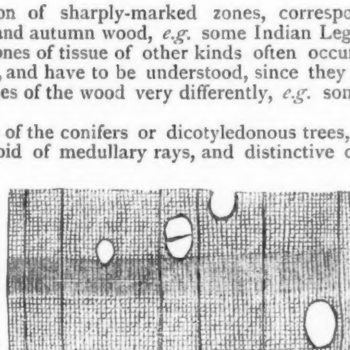


FIG. 7.—Transverse section of the wood of *Pongamia glabra*, Vent., selected to show a type of timber not uncommon in India. No distinct annual rings appear, but the wood is traversed by wavy bands of tissue, which may run into one another or not. The vessels ("pores") are few and scattered, and differ in size; the medullary rays well marked, but not large. To this type—differing in other details—belong many species of figs, acacias, and other Asiatic Leguminoseæ, &c.

formation of sharply-marked zones, corresponding to spring and autumn wood, *e.g.* some Indian Leguminosæ, &c. Zones of tissue of other kinds often occur in such timbers, and have to be understood, since they affect the properties of the wood very differently, *e.g.* some of the Figs.

None of the conifers or dicotyledonous trees, however, are devoid of medullary rays, and distinctive characters

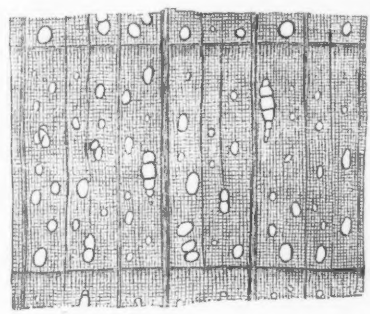


a

FIG. 8.—Transverse section of wood of *Tamarindus indica*, Linn., selected to show a not uncommon type of Asiatic timber. The annual rings are indistinct, but occasionally indicated by denser tissue (*a*). The vessels are fairly large and few, and scattered much as in Fig. 7, but there are no such broad bands of cells as there.

are based on the breadth and numbers of these: as examples for contrast may be cited the fine rays of the Pines and Firs, and the coarse obvious ones of the Oaks.

Again, the prominence or minuteness, or even (Coniferæ) absence, of vessels in the secondary wood afford characters for classification. The contrast between the extremely small vessels of the Box and the very large ones of some Oaks and the Chestnut, for instance, is too striking to be overlooked. Then, again, in some timbers the vessels are distributed more or less equably throughout the "annual ring," as in the Alder, some Willows and Poplars, &c.; whereas in the Chestnut and others they are especially grouped at the inner side of the annual zone (*i.e.* in the spring wood), and in some cases these



c

a

FIG. 9.—Transverse section of the wood of *Acer pseudo-platanus*, selected to show a type of timber common in Europe. The annual rings (*a*) are well-marked and regular. The vessels are small and numerous, and scattered somewhat equally over the whole breadth of the ring. The medullary rays are numerous, some broad, some fine. Many European timbers (beech, hornbeam, lime, &c.) agree with this type, except in details.

groupings are such as to form characteristic figures on the transverse section, as in some Oaks, *Rhamnus*, &c. In the woodcuts (Figs. 7–10) I have given four examples illustrating a few of the chief points here adverted to.

Passing over peculiar appearances due to the distribution of the wood-parenchyma between the vessels, as

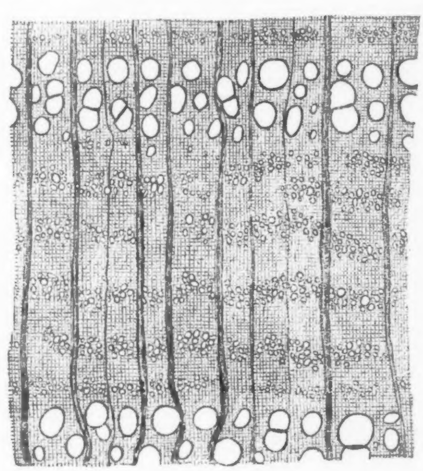


FIG. 10.—Transverse section of wood of the common elm (*Ulmus campestris*), selected as a common type of European timber. The annual rings are very distinct, owing to the large vessels in the spring wood; the vessels formed during the summer and autumn are grouped in bands or zones. The medullary rays are numerous, but not very broad. The oak, ash, chestnut, and others agree in the main with this type, differing chiefly in the *mode of grouping* of the smaller vessels, and in the *breadth* of the medullary rays.

exemplified by the Figs and the Maples, as well as minor but conspicuous features which enable experts to recognize the timber of certain trees almost at a glance, I may now proceed to indicate a few other peculiarities which distinguish different timbers.

The weight of equal volumes of different woods differs

more than is commonly supposed, and there are certain details to be considered in employing weight as a criterion which have not always been sufficiently kept in mind.

A cubic foot of "seasoned" timber of the Indian tree *Hardwickia binata* weighs about 80 lbs. to 84 lbs., while a cubic foot of *Bombax malabaricum* may weigh less than 20 lbs., and all gradations are possible with various timbers between these or even greater extremes. If we keep in mind the structure of wood, it is evident that the weights of equal volumes of merely seasoned timber will yield only approximate results. For even if the seasoning, weighing, &c., are effected in a constant atmosphere, woods which differ in "porosity" and other properties will differ in the extent to which they absorb moisture from damp air or give it up to dry air.

In our climate, timber which is felled in April or May, generally speaking, contains much more water than if felled in July and August: it is, in fact, no uncommon event to find that about half the weight, or even more, of a piece of recently felled timber is due to the water it contains. If this water is driven off by heat, and the piece of wood thoroughly dried, the latter will be found to weigh so much less, but it will increase in weight gradually as it imbibes moisture again.

Now it happens that the weight of a piece of timber, compared with that of an equal volume of some standard substance—in other words, the specific weight—is of very great importance, because several other properties of wood stand in relation with it, *e.g.* the hardness, durability, value as fuel, tendency to shrink, &c. Fresh-cut timber in very many cases contains on an average about 45 to 50 per cent. of its weight of water, and if "seasoned" in the ordinary way this is reduced to about 15 to 20 per cent.; but the fresh timber also contains air, as may easily be shown by warming one end at the fire or in hot water and watching the bubbles driven out, and the seasoned timber contains less water and more air in proportion, so that we see how many sources of error are possible in the usual weighings of timber. At the same time, many comparative weighings of equal volumes of well-seasoned timber do yield results which are of rough practical use.

The fact is that the so-called "specific weight" of timber, as usually given, is not the specific gravity of the wood-substance, but of that *plus* entangled air and water. It is interesting to note that, although we associate the property of floating with wood, timber deprived of its air will sink rapidly, being about half as heavy again as water, volume for volume.

The point just now, however, is not to discuss these matters in detail, but rather to indicate that, other things equal, the density of a piece of timber will be greater, the more of that closely-packed, thick-walled autumn wood it contains; while the timber will be specifically lighter and contain more air when dry, the greater the proportion of the looser, thin-walled spring wood in its "annual rings." In other words, if we could induce the cambium to form more autumn wood and less spring wood in each annual ring, we could improve the quality of the timber; and, in view of the statement which has been made, to the effect that large quantities of timber of poor quality reach the Continental wood-yards every year, this is obviously an important question, or at any rate may become one. The remainder of this article must be devoted to this question alone, though it should be mentioned that several other questions of scientific and practical importance are connected with it.

The first point to notice is that the cambium-cells, like all other living cells which grow and divide, are sensitive to the action of the environment. If the temperature is too high or too low, their activity is affected and may even be brought to an end; if the supply of oxygen is too small, their life must cease, since they need oxygen for respiration just as do other living cells; if they are deprived of water, they cannot grow—and if they cease to grow they cannot divide, and any shortcomings in the matter of water-supply will have for effect a diminution of activity on the part of the cambium. The same is true of the supply of food-substances: certain mineral salts brought up from the soil through the roots, and certain organic substances (especially proteids and carbo-hydrates) prepared in the leaves, are as necessary to the life of a cambium-cell as they are to the life of other cells in the plant. Now, since the manufacture of these organic substances depends on the exposure of the green leaves to the light, in an atmosphere containing small quantities of carbon-dioxide, and since the quantities manufactured are in direct relation to the area of the leaf-surface—the size and numbers of the leaves—it is obvious that the proper nourishment of the cambium is directly dependent on the development of the crown of foliage in a tree. Again, since the amount of water (and mineral salts dissolved in it) will vary with the larger or smaller area of the rootlets and absorbing root-hairs (other things equal), this also becomes a factor directly affecting our problem. Of the interdependencies of other kinds between these various factors we cannot here speak, since they would carry the argument too far for the space at command; some of them are obvious, but there are correlations of a subtle and complex nature also.

First as to temperature. The dormant condition of the cambium in our European winter is directly dependent on the low temperature: as the sun's rays warm the environment, the cambial cells begin to grow and divide again. The solar heat acts in two ways: it warms the soil and air, and it warms the plant. Wood, however, is a bad conductor of heat, and the trunk of a tree is covered by the thick corky bark, also an extremely bad conductor, and it would probably need the greater part of the early summer to raise the temperature of the cambium sufficiently for activity in the lower parts of a tree by direct solar heat: the small twigs, on the contrary, which are covered by a thin layer of cortex, and epidermis, are no doubt thus warmed fairly rapidly, and their early awakening is to be referred to this cause. The cambium in the trunk, however, is not raised to the requisite temperature until the water passing up through the wood from the roots is sufficiently warm to transmit some of the heat brought with it from the soil to the cells of the cambium. This also is a somewhat slow process, for it takes some time for the sun's rays to raise the temperature of the soil while the days are short and the nights cold. Hartig has shown that the cambium in the lower part of the trunk of a tree may be still dormant three weeks or a month after it has begun to act in the twigs and small branches; and it has also been pointed out that trees standing in open sunny situations begin to renew their growth earlier than trees of the same species growing in shady or crowded plantations, where the moss and leaf-mould, &c., prevent the sun from warming the soil and roots so quickly. These observations have also a direct bearing on the later renewal of cambial activity in trees growing on mountains or in high latitudes. Moreover, though I cannot here open up this interesting subject in detail, these facts have their connection with the dying off of temperate trees in the tropics, as well as with the killing of trees by frost in climates like our own. One important practical point in this connection may be adverted to. Growers of conifers are well aware that certain species cannot be safely grown in this country (or only in favoured spots) because the sun's rays rouse them to activity at a time when spring frosts are still common at night, and their young tissues are destroyed by the frosts. Prof. R. Hartig has pointed out a very instructive case. The larch is an Alpine plant, growing naturally at elevations where the temperature of the soil is not high enough to communicate the necessary stimulus to the cambium until the end of May or June.

Larches growing in the lowlands, however, are apt to begin their renewed growth in April, and frosted stems are a common result, a point which (as the renowned botanist just referred to also showed) has an important bearing on that vexed question—the "larch-disease."

The supply of oxygen to the cambium is chiefly dependent on the supply of water from the roots, and the aëration of the stem generally. The water begins to ascend only when the soil is warm enough to enable the root-hairs to act, and new ones to be developed, and the supply of mineral salts goes hand in hand with that of water.

Now comes in the question of the sources of the organic substances. There is no doubt that the cambium at first takes its supply of food-materials from the stores which have been laid by, in the medullary rays, &c., at the conclusion of the preceding year; and it is known that special arrangements exist in the wood and cortex to provide for this when the water and oxygen arrive at the seat of activity.

Assuming that all the conditions referred to are favourable, the cambium-cells become filled with water in which the necessary substances are dissolved, and distended (become turgid, or turgescent, as it is technically called) sufficiently for growth. Speaking generally, and with reference chiefly to the trunk of the tree, which yields the timber, the distension of the cells is followed by growth in the direction of a radius of the stem, and division follows in the vertical plane, tangential to the stem. Then the processes already described with reference to Fig. 5 repeat themselves, and the trunk of the tree grows in thickness.

Now it is obvious that the thickening of the mass of timber inside the cylinder of cambium must exert pressure on the cortex and bark—must distend them elastically, in fact—and some ingenious experiments have been made by De Vries and others to show that this pressure has an effect in modifying the radial diameter of the cells and vessels formed by the cambium. Several observers have promulgated or accepted the view that the differences between so-called spring and autumn wood are due to the variations in pressure of the cortex on the cambium, but the view has lately gained ground, based on experimental evidence, that these differences are matters of nutrition, and a recent investigator has declared that the thick-walled elements and small sparse vessels characteristic of autumn wood can be produced, so to speak, at will, by altering the conditions of nutrition.

It is authoritatively stated that the pines of the cold northern countries are preferred for ships' masts in Europe, and that the wood-cutters and turners of Germany prize especially the timber of firs grown at high elevations in the Bavarian Alps. Now the most striking peculiarity of the timbers referred to is the even quality of the wood throughout: the annual rings are close and show less of the sharp contrasts between thin-walled spring wood and thick-walled autumn wood, and Hartig suggested that this is due to the conditions of their nutrition, and in the following way. The trees at high elevations have their cambium lying dormant for a longer period, and the thickening process does not begin in the lower parts of the trunk until the days are rapidly lengthening and the sun's rays gaining more and more power: the consequence is that the spring is already drawing to a close when the cambium-cells begin to grow and divide, and hence they perform their functions vigorously from the first.

One of the most interesting experiments in this connection came under my observation this summer, owing to the kindness of Prof. Hartig. There is a plantation of larches at Freising near Münich, with young beeches growing under the shade of the larches. The latter are seventy years old, and are excellent trees in every way. About twenty years ago these larches were deteriorating seriously, and were subsequently "under-planted" with beech, as foresters say—*i.e.* beech-plants were introduced under the shade of the larches. The recovery of the latter is remarkable, and dates from the period when the under-planting was made.

The explanation is based on the observation that the fallen beech-leaves keep the soil covered, and protect it from being warmed too early in the spring by the heat of the sun's rays. This delays the spring growth of the larches: their cambium is not awakened into renewed activity until three weeks or a month later than was previously the case, and hence they are not severely tried by the spring frosts, and the cambium is vigorously and continuously active from the first.

But this is not all. The timber is much improved: the annual rings contain a smaller proportion of soft, light spring wood, and more of the desirable summer and autumn wood consisting of closely-packed, thick-walled elements. The explanation of this is that the spring growth is delayed until the weather and soil are warmer, and the young leaves in full activity; whence the cambium is better nourished from the first, and forms better tracheides throughout its whole active period. Such a result in itself is sufficient to repay the investigations of the botanist into the conditions which rule the formation of timber, but this is by no means the only outcome of researches such as those carried on so assiduously by Prof. Hartig in Münich, and by other vegetable physiologists.

It is easy to understand that the toughness, elasticity, and such like qualities of a piece of timber, depend on the character of the tracheides, fibres, &c., of which it is chiefly composed. Investigations are showing that the length of such fibres differs in different parts of the tree. Sanio has already demonstrated that in the Scotch pine, for instance, the tracheides differ in length at different heights in the same trunk, becoming longer as we ascend, and also are longer in the outer annual rings than in the inner ones as the tree grows older, up to a certain period; and this is in accordance with other statements to the general effect that for many years the wood improves, and that better wood is found at the base of the trunk.

However, it is impossible to pursue these subjects in all their details: my object is served by showing how well worthy of the necessary scientific study is timber even to those who are only concerned with it in its usual conditions, and within those limits of variation in structure and function which constitute health. The importance of the subject in connection with the modern development of biology along the grand road of comparative physiology, does not need insisting upon here. It will be the object of further articles to show how it is, if possible, still more important and interesting to know the structure and functions of healthy timber, before the practical man can understand the diseases to which timber is subject. At the same time it must be clearly borne in mind that these are but sketches of the subject; for it is as true of trees and their diseases as it is of men and human diseases, if you would be trainers and doctors you must know thoroughly the structures and peculiarities of the beings which are to be under your care.

H. MARSHALL WARD.

(*To be continued.*)

NOTES.

THE collections of natural history lately forwarded to the British Museum by Dr. Emin Pasha, from Central Africa, will be described at the meeting of the Zoological Society on January 17. The specimens have been determined by various experts in the different branches of natural history to which they belong. Mr. Oldfield Thomas has prepared a paper on the mammals, amongst which are examples of a remarkable

new species of *Hyrax*. Captain Shelley will contribute a paper on the series of birds, which also embraces several new forms. The Lepidoptera have been worked out by Mr. A. G. Butler, and contain specimens of thirteen butterflies new to science. Mr. Edgar A. Smith has examined the fresh-water shells which Dr. Emin Pasha obtained on the Lake Albert Nyanza. They are referable to five species only, but three of these, as might have been expected from the novel locality in which they were obtained, appear to be new to science.

THE Physical Society, of which Dr. Balfour Stewart was President, was represented at his funeral by three of its members: Mr. J. Johnstone Stoney, Prof. G. F. Fitzgerald, and Prof. W. F. Barrett.

IN a lecture lately delivered by Sir Douglas Galton at the Parkes Museum, he drew attention to the increase every year of fog and smoke in London, and to the possibility of their abatement. Dr. Russell's experiments, carried out at St. Bartholomew's Hospital, for the Meteorological Council, showed that the City rain contained twice as much impurity as that collected in the suburbs. That is to say, if the City rain were diluted with nearly an equal bulk of water, we should have the rain of the suburbs. He referred to the experiments of Prof. Lodge with a bell-jar filled with smoke, which is quickly deposited by a discharge of electricity, and argued that by disturbing the electrical condition of the air by kites or balloons, rain may be caused, and by this means the fog dislodged. Failing this, nothing remains but to use gas instead of open stoves, but this method at present costs about four times as much as coal.

WE learn from the *Annales Industrielles* that a mine-shaft is being successfully sunk by M. Alexandre, of the Houssu Company, in Belgium, through a stratum of moist sand 12 metres thick, met with at 70 metres depth, by the Poetsch method, which consists in freezing the sand, then excavating it like rock. In the present case ten iron tubes (with cutting crown) are inserted in the sand at about 1 metre interval, penetrating the coal below. Into these are put other tubes, through which is passed a very cold liquid to return by the larger tubes (generally chloride of magnesium cooled by expansion of ammonia). The sand is frozen more than 3 metres round the tubes. It has the appearance of a rock harder than the compact chalk of the English Channel tunnel; it is sparkling, and speckled with particles of coal. The chloride of magnesium, injected at -14° C., returns at -12°. A thermometer inserted 10 centimetres in the stratum read -8°. M. Poetsch's method was lately applied to making a tunnel at a small depth under part of the city of Stockholm.

WATERSPOUTS are sometimes seen on the Lake of Geneva, and M. Dufour has made a study of one which occurred on August 19, about 7.30 a.m. (*Arch. des Sciences*). It seems to have arisen on the lake at the meeting of two winds, one from the south, in the eastern part of the lake, and the other from the west, in the western; and its path was along the line of demarkation, changing direction somewhat as it neared the northern shore. Some testified to a rising of the water, which was in violent rotation (in the direction of the hands of a watch). The base of the column was like whirling opaque smoke, which rose in widening spiral, lost above in the cloud. The column was considerably inclined, the upper part advancing more quickly than the lower. In the rear was heavy rain. It is estimated that the *trombe* was about 2 to 3 metres in diameter at foot, and about 106 metres high, and its rate of progress about 760 metres per minute (the speed of an express train). On reaching the shore it disappeared, doing no harm either to vineyard or railway, and had the look of a serpent drawing in its tail. The weather was very variable that day, from hour to hour, and from one part of the lake to another. There was no thunder nor lightning.

THE United States Monthly Weathly Review for September last shows nine depressions in the Atlantic Ocean, of which five were of tropical or sub-tropical origin. Three advanced eastwards from the American Continent north of 45° N., and one appeared over the British Isles. Three of the depressions moved across the Atlantic to Western Europe. As compared with September 1886, there was a slight decrease in the quantity of ice reported; this year the northern limit was lat. 45° 37′ N., and the eastern limit long. 40° 50′ W.

THE Port Officer of Madras has given notice, dated September 22, 1887, that the following storm-signals have been adopted at the ports of the Madras Presidency, instead of the flags hitherto used:—Day-signals: a ball indicates the probable approach of dangerous weather; a drum indicates that a cyclone is likely to approach the port; a cone, apex upwards, at the flag-staff of the port, indicates that it is decided the shipping shall be ordered to sea. Night-signals: three lights, hoisted vertically one above the other, indicate the probable approach of dangerous weather; two lights, hoisted vertically one above the other, indicate that a cyclone is likely to approach the port; three bright lights, hoisted triangularly, one at the mast-head and one at each yard-arm of the flag-staff of the port, indicate that it is decided the shipping shall be ordered to sea.

AT the conclusion of the Colonial and Indian Exhibition some specimens of the American lake-trout (*S. namaycush*), which had been hatched and reared in the Canadian Section, were put in a tank, where they prospered. One fish especially prospered, surpassing the others in size by an inch. In the course of this year they have all disappeared, with the exception of the one referred to, whose colossal form accounts for its missing congeners, which evidently became its prey. Mr. W. August Carter, of the National Fish-Culture Association, states that about 50,000 of these fish were hatched at South Kensington two years ago, when he observed them attack one another soon after leaving their sac. There is a great diversity of growth among them—greater than that which exists among British trout.

A CURIOUS incident is reported by Mr. William Burgess, proprietor of the Midland Counties Fish-Culture Establishment. He states that a pond constructed by him last March, measuring 50 feet by 30 feet, which is entirely isolated from other similar ponds, was shortly after its formation found to be populated with trout fry in their alevin stage. No fish of any kind had been placed in the pond, and none could have entered it, the inlet and outlet being blocked with perforated zinc of a very fine mesh. The soil of the pond in question was excavated from a brook where trout must have previously spawned, and the ova, although buried in mud and flung heedlessly about, survived, and the fry came to life when water had been let into the pond. This is another proof of the enduring capacity of *Salmonidæ* ova.

AT a recent meeting of the Paris Biological Society, M. L. Vaillant offered some remarks concerning the way in which *Antennarius marmoratus*, a curious fish already studied by Agassiz, builds its nest. Each nest is made of one sea-weed (of the Sargasso Sea) the different twigs being brought together and made fast to each other by the fish by means of a pasty sort of substance provided by the animal itself. Agassiz thought that separate bits of sea-weed were used, but it is shown that it uses the whole of the twigs and branches of a single plant; which, of course, allows of much easier work.

THAT the weasel (*Mustela vulgaris*) destroys frogs is proved by the following incident. While standing near a pond on his estate, a gentleman at Worcester observed a weasel give chase to a frog, which it followed to the water and succeeded in capturing. Holding it firmly by the head, the weasel emerged from the water and brought its victim to the bank, but on finding

itself disturbed let go the frog and disappeared. Happening to visit the spot on the succeeding day the gentleman found the frog alive in exactly the same place where it had been left by the weasel, although it had been bitten through to the skull.

AT a recent meeting of the Jena Naturalists' Society, Herr Stahl read a paper on the significance of those excreta of plants known as *raphides*, *i.e.* crystalline needles often met with in the cells in large quantity. From experiments he inferred that they were a protection to plants against being eaten by animals. Many animals avoid plants with raphides, or eat them reluctantly; and some animals, *e.g.* snail species, in eating plants that have raphides select those parts that are without the crystals. Many plants held for poisonous, *e.g. Arum maculatum*, owe their burning taste simply to the very numerous raphides, which, forced out of their cells, enter the tongue and palate. The juice obtained by filtration has quite a mild taste.

WE have received the Proceedings of the Academy of Natural Sciences of Philadelphia, Part 2, April to August 1887. The volume contains a valuable paper, by Mr. Edward Potts, presenting "Contributions towards a Synopsis of the American Forms of Fresh-water Sponges, with descriptions of those named by other authors, and from all parts of the world." In closing this monograph, Mr. Potts says he knows of no more hopeful field of labour for a young American naturalist, seeking for new worlds to conquer, than that provided by the fresh-water sponges. Active workers in this field in North America have, thus far, but glanced at a few streams and lakes, mostly in the neighbourhoods of Buffalo, Chicago, and Philadelphia, and in parts of Florida, Nova Scotia, and Newfoundland. Mr. Potts has little doubt that the rest of the American continent holds many rare prizes in trust for younger and better-equipped explorers.

ANOTHER important paper by Dr. B. Franke, of Leipzig, upon the preparation and constitution of the hydrates of manganic oxide and peroxide is contributed to the current number of the *Journal für Praktische Chemie*. By the action of 100 c.c. concentrated sulphuric acid upon 8 grammes potassium permanganate, a beautiful dark reddish-brown crystalline salt was obtained of the composition $Mn_2(SO_4)_3 . H_2SO_4 . 4H_2O$. When the crystals of this salt were placed in a solution of soda, they were decomposed with deposition of a crystalline powder. These precipitated minute crystals were found to consist of the hydrate of manganic oxide, $Mn_2O_3 . H_2O$, and were shown to possess the constitution $\mathrm{Mn}{<}^{\mathrm{O}}_{\mathrm{O}}{>}\mathrm{Mn}{<}^{\mathrm{OH}}_{\mathrm{OH}}$; they were of a steel-gray colour, and possessed metallic lustre. On heating to a temperature exceeding 120°, water was evolved, and black Mn_2O_3 remained. When, however, the reddish-brown salt was dissolved in dilute sulphuric acid, a precipitate afterwards separated out, consisting of pure manganous acid, $MnO_2 . H_2O$, of constitution ${}^{\mathrm{HO}}_{\mathrm{HO}}{>}\mathrm{MnO}$. On rapidly filtering and washing with water, alcohol, and ether, the acid was obtained as a brown powder, which on ignition became transformed into black Mn_3O_4. One of the most interesting results of similar experiments with hydrochloric acid, which behaves in a precisely analogous manner, is that they throw considerable light upon the mode of action of hydrochloric acid upon manganese dioxide, the reaction so commonly employed for the preparation of chlorine. The first action is shown to consist in the formation of a chlorine substitution-product of manganous acid, thus: $MnO_2 + 6HCl = H_2MnCl_6 + 2H_2O$. This substance is, however, rapidly broken up into manganous chloride, hydrochloric acid, and free chlorine: $H_2MnCl_6 = Cl_2 + MnCl_2 + 2HCl$. A secondary action then commences, the manganous chloride thus formed combines with further quantities of the chlorine substitution-product to form manganic chloride: $MnCl_2 + H_2MnCl_6 = Mn_2Cl_6 + 2HCl$. The manganic chloride, as is well known, does not remain as such, and Dr. Franke shows that, like the sulphate, it is at once decomposed by water as follows: $Mn_2Cl_6 + 4H_2O = Mn_2O_3 . H_2O + 6HCl$. Finally, the free hydrochloric acid decomposes the crystalline hydrate with formation of stable manganous chloride. It is especially important to have this reaction thus thoroughly cleared up, as it is one of the earliest brought to the attention of students.

A NEW method of determining the amount of fusel oil in spirituous liquors, by counting drops from an instrument named a *stalagmometer*, has been lately brought before the Berlin Chemical Society by Herr Traube, who had previously worked out such determinations with a capillarimeter, but finds the new plan preferable on some accounts. The instrument is a short, bent glass tube bulged at one part, into which the liquor is sucked up, being previously diluted to about 20 vols. per cent. The room-temperature being noted, the number of drops in a given volume is counted, and then compared with the corresponding number got at the same temperature from pure 20 per cent. alcohol. A plus of about 1·6 drop per cent. in the former case indicates about 0·1 per cent. fusel oil; one of about 3 5 drops 0·2 per cent. fusel oil, and so on. Even 0·05 per cent. can be certainly determined, and, while the author considers this arrangement quite sufficient for practice, he describes an improved form of his method which admits of determining 0·02 per cent. fusel oil, as well as etheric oils, &c. In this the fusel oil is first expelled from its solution by means of certain salts.

IN a recent series of experiments on the resistance of materials to frost, Herr Blümcke took the method of putting cubes of various kinds of stone in distilled water, under the receiver of an air-pump, and after the air was exhausted and the cube saturated with liquid, exposing the latter to a freezing mixture. He finds that a material is more resistant the less the weight of particles it loses in a given number of freezings. The results corresponded pretty much to experience. Besides the well-known visible phenomena of weathering, there is, even in the first action of frost, a loss of extremely fine particles, not perceptible in the material itself. The appearance of the visible phenomena occurs sooner the more water the stone has taken up. The mode of working has a not unimportant influence on the resistance of materials.

AT the monthly meeting of the Linnean Society of New South Wales, held October 26, Dr. Oscar Katz read a paper on three new kinds of phosphorescent Bacteria, in addition to three already recorded by the author at the meeting of last June: (1) *Bacillus argenteo-phosphorescens liquefaciens*, obtained from sea-water at Bondi; its cultures, liquefying gelatine, emit in the dark a silvery light, which, however, is the weakest of the six kinds hitherto found; (2) *Bacillus argenteo-phosphorescens* II., derived from a luminous piece of a small squid (*Loligo*), and, at the same time, from luminous pieces of the Sydney Garfish (*Hemirhamphus intermedius*, Cant., *H. melanochir*, Cuv. and Val.); (3) *Bacillus argenteo-phosphorescens* III., from the squid already mentioned. Neither of the latter micro-organisms causes liquefaction of the gelatine. They give off in the dark a handsome silver light, much more intense than that of the first-mentioned, but resembling that of the previously-exhibited *Bacillus argenteo-phosphorescens* (now to be designated I.). From this latter Nos. II. and III. distinctly differ. Fuller details about all these luminous Bacteria will be forthcoming shortly.

DURING his last journey to the Amdo, M. Potanin discovered an interesting manuscript containing a Tibetan version of the Mongolian epics of Hesser-Khan. Speaking of this discovery, Prof. Vasilieff has lately expressed his belief that travellers might, if they tried, find many valuable manuscripts in Eastern Turkistan

—relics of the earlier Buddhist era and of the Chinese dominion. Such treasures are probably also to be found in Japan and Corea. It is known that there are Japanese versions of Hiuan Thsang's journey; and Prof. Vasilieff has been informed that manuscripts written on palm-leaves, and brought from India, have been seen in Corea. Many Coreans formerly visited India as Buddhist pilgrims.

A LIST of publications issued by the authority of the Department of Science and Art has just been published. It includes publications specially relating to instruction in science and art, publications relating to the South Kensington Museum, catalogues of reproductions and of loan collections, miscellaneous publications, hand-books, books of photographs, and diagrams.

MESSRS. GIARD AND BONNIER have just published a valuable memoir on the anatomy of the Bopyridæ, with good illustrations.

WHALES—the so-called "herring" whales, which follow the shoals of that fish—are very numerous off the west coast of Norway this winter, and large catches have been made.

IN the Report of a Committee appointed by the British Association "for the purpose of investigating . . . the quantity and character of the water supplied to various towns and districts" from the permeable formations of England, a very misleading statement as to the character of the water-supply of Cheltenham was made. In a later Report of the same Committee, just issued, the error is frankly admitted. "In the Eleventh Report of your Committee," we read, "by a most unfortunate misprint, the reservoirs are described as 'dry' during the drought of 1884, instead of 'short,' as reported by a correspondent, in which statement he was obviously incorrect. Your Committee much regret that the condition of the Cheltenham Waterworks should have been misrepresented by them, as they were fully aware of the ample supply and pure quality given to the town by the Corporation, the purity of which has been testified to by Drs. Allen Miller, Frankland, Way, and Tidy, and Prof. Voelcker."

THE *Brighton Herald* says it is expected that the medallion portrait of the late Dr. Thomas Davidson, F.R.S., Gold Medallist of the Royal Society, Wollaston Medallist of the Geological Society, and first Chairman of the Brighton Museum Committee, executed in marble for the Committee of the Davidson Memorial by Mr. Thomas Brock, A.R.A., will be unveiled early in the new year. The work is said to be an excellent likeness.

A SHOCK of earthquake was reported from Oberhausen on December 9. The direction was from west to east.

LAST week Sir John Lubbock delivered an interesting address in Queen Street Hall, Edinburgh, to the members of the Edinburgh Philosophical Institution on "The Sense and Senses of Animals." He said one would gratefully admit that the dog was a loyal and true and affectionate friend, but when we came to consider the nature of the animal our knowledge was very limited. That arose a good deal from the fact that people had tried rather to teach animals than to learn from them. It had occurred to him that some such method as that which was followed in the case of deaf-mutes might prove instructive if adapted to the case of dogs. He had tried with a black poodle belonging to himself. He then went on to relate several experiments he had made with pieces of cardboard with different words marked upon them. He had taken two pieces of card, one blank and the other with the word "food" upon it. He had put the latter on a saucer containing some bread and milk, and the blank card he put on an empty saucer. The dog was not allowed to eat until it brought the proper card to him. This experiment was repeated over and over again, and in about ten days the dog began to distinguish the card with the letters on it from the plain card. It took a longer time to make the dog realize the difference between different words. In order to try and discover whether the dog could distinguish colours, he prepared six cards, marking two of them blue, two yellow, and two orange. He put one of each on the floor, and tried to get the dog to bring to him a card with the same colour as one which he showed the dog in his hand. After trying this for three months, he found that his experiment in this direction was a failure. He had always felt a great longing to know how the world appeared to the lower animals. It was still a doubtful point whether ants were able to hear. From experiments which he had made, he had come to the conclusion they had not the power of addressing each other. His impression on the whole was that bees and ants were not deaf, but that they heard sounds so shrill as to be beyond our hearing. There was no doubt about insects seeing. He related several experiments he had made with the view of discovering whether different insects could distinguish different colours and had any preference for particular colours. The colours of objects produce upon insects an impression very different from that produced on human beings. The world to them might be full of music which we could not hear, colours which we could not see, and sensations which we could not feel.

THE additions to the Zoological Society's Gardens during the past week include a White-crested Guan (*Pipile jacutinga*) from Guiana, presented by Captain J. Smith, s.s. *Godiva*; two Silky Bower Birds (*Ptilonorhynchus violaceus*) from New South Wales, deposited; two Viscachas (*Lagostomus trichodactylus*) born in the Gardens.

ASTRONOMICAL PHENOMENA FOR THE WEEK 1888 JANUARY 1–7.

(FOR the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is here employed.)

At Greenwich on January 1

Sun rises, 8h. 8m.; souths, 12h. 3m. 39·5s.; sets, 15h. 59m.: right asc. on meridian, 18h. 46·0m.; decl. 23° 2′ S. Sidereal Time at Sunset, 22h. 42m.

Moon (at Last Quarter on January 6, 12h.) rises, 17h. 29m.*; souths, 1h. 31m.; sets, 9h. 25m.: right asc. on meridian, 8h. 12·0m.; decl. 19° 10′ N.

Planet.	Rises. h. m.	Souths. h. m.	Sets. h. m.	Right asc. on meridian h. m.	Declination on meridian ° ′
Mercury..	7 33	11 19	15 5	18 1·7	24 19 S.
Venus ...	4 19	8 55	13 31	15 37·1	16 38 S.
Mars ...	0 21	6 9	11 57	12 50·3	3 6 S.
Jupiter ...	4 37	9 0	13 23	15 42·1	18 47 S.
Saturn ...	17 59*	1 49	9 39	8 29·2	19 31 N.
Uranus...	0 50	6 23	11 56	13 3·9	6 5 S.
Neptune.	13 19	20 59	4 39*	3 43·0	17 57 N.

* Indicates that the rising is that of the preceding evening and the setting that of the following morning.

Occultations of Stars by the Moon (visible at Greenwich).

Jan.	Star.	Mag.	Disap. h. m.	Reap. h. m.	Corresponding angles from vertex to right for inverted image. ° °
1	*d′* Cancri ...	6	4 13	near approach	200 —
5	*b* Virginis...	6	2 16	3 24	53 209

Jan.	h.	
1	9	Saturn in conjunction with and 0° 55′ north of the Moon.
2	16	Venus in conjunction with and 1° 51′ north of Jupiter.
4	1	Mercury at greatest distance from the Sun.
6	9	Mars in conjunction with and 2° 46′ south of the Moon.

Saturn, January 1.—Outer major axis of outer ring = 45″·8; outer minor axis of outer ring = 15″·1; southern surface visible.

Variable Stars.

Star	R.A. (1888·0) h. m.	Decl. (1888·0) ° ′		h. m.	
U Cephei	0 52·4	... 81 16 N. ...	Jan.	5, 22 42	*m*
Algol	3 0·9	... 40 31 N. ...	,,	3, 18 55	*m*
λ Tauri...	3 54·5	... 12 10 N. ...	,,	3, 18 23	*m*
ζ Geminorum ...	6 57·5	... 20 44 N. ...	,,	3, 23 0	*M*
R Canis Majoris...	7 14·5	... 16 12 S. ...	,,	2, 20 46	*m*
			,,	4, 0 2	*m*
U Virginis	12 45·4	... 6 10 N. ...	,,	7,	*M*
δ Libræ	14 55·0	... 8 4 S. .	,,	1, 21 9	*m*
R Libræ	15 47·3	... 15 54 S. ...	,,	5,	*M*
U Ophiuchi	17 10·9	... 1 20 N. ...	,,	3, 3 52	*m*
		and at intervals of		20 8	
R Lyræ	18 51·9	... 43 48 N. ...	Jan.	1,	*m*
R Sagittarii... ...	19 10·1	... 19 3 S. ...	,,	3,	*M*
R Sagittæ	20 9·0	... 16 23 N. ...	,,	3,	*m*
T Vulpeculæ ...	20 46·7	... 27 50 N. ...	,,	3, 4 0	*m*
Y Cygni	20 47·6	... 34 14 N. ...	,,	1, 21 26	*m*
			,,	4, 21 19	*m*
δ Cephei	22 25·0	... 57 51 N. ...	,,	2, 19 0	*M*

M signifies maximum; *m* minimum.

Meteor-Showers.

	R.A.	Decl.	
Near ζ Cancri... ...	119° ...	16° N. ...	Bright and swift.
,, θ Ursæ Majoris	140 ...	57 N. ...	Very swift and short.
The *Quadrantids* ...	228 ...	53 N. ...	January 1, 2, and 3.

GEOGRAPHICAL NOTES.

THE two great medals of the Paris Geographical Society have been awarded to General Alexis de Tillo for his great topographical work on Europe and Asia, and to M. Alphaud, Inspector-General of the Ponts et Chausées, who, "by inspiring a feeling for the beautiful and of the necessities of hygiene, has done so much to improve the topography of the capital." Medals of the first class were awarded to M. Enguehard, geographical draughtsman; Prof. François Bazin; Prof. Maxime Mabire; Prof. Paul Gaffarel, for a work on the soil of France; M. Fauve, for his fine topographical works; M. Ch. Lasalle, for a work on the defences of France; M. Pierre Collet, for his relief plans; Lieut. Somprou; M. Poinet; and M. Verragen.

LIEUT. VON FRANÇOIS and Dr. Wolf will start shortly on a scientific mission to Togoland, one of the German possessions on the West Coast of Africa.

IN the new part of the Journal of the Manchester Geographical Society there is an instructive paper by the Rev. R. P. Ashe on Uganda, and the manners and customs of its people.

NEWS from Africa states that the well-known African traveller, Herr Gottlob Adolf Krause, has returned to Accra on the Gold Coast. In May 1886 he commenced his exploring expedition. Starting from Accra and crossing the River Acropang-Volta at Kpang, he proceeded in an easterly direction, passing through Kpando, Krahje, Salaga, Dagomba, Walawala, East Gurunsi, and Busanga to Wagaduga and Ban Djagara, penetrating to within a few miles of Timbuctoo. On his return he journeyed through West Gurunsi, the Ashantee District, Kintimso, Salaga, Sogede, Baleta, Gheshi, Atakpama, and Pla. Lieut. Kund on his journey to Cameroon met Herr Krause at Accra, and sends this report. Herr Krause states that to the north of Salaga the influence of the Sahara is most prominent, and the country is more desolate the further north one goes. Rice and tobacco are universally cultivated. The principal articles of commerce are kola-nuts and salt, the district being chiefly inhabited by the Fula tribe. Nearer to the coast there are several other tribes and dialects, but the Haussa language is most generally spoken. Most of the population is still heathen, but some of the merchants and better educated families are Mohammedans. Herr Krause was not enabled to proceed as far as Timbuctoo, owing to the unfriendliness of the Sheikh Tidchani.

THE *Bollettino* of the Italian Geographical Society for October and November publishes a valuable paper by Sig. A. Borda on the geography, history, and present social conditions of the Republic of Columbia (New Grenada), which promises to enter on an era of peace and prosperity under its enlightened and popular President Nunez, who was elected last June for a term of six years. The present population is calculated on official returns at about four millions, including 200,000 still living in the tribal state in the more inaccessible forest regions. These forests are described as abounding in a great variety of valuable trees yielding the finest cabinet woods, balsams, gums, dyewoods, alimentary and medicinal products. The flora and fauna are scarcely exceeded by those of any other land in diversity of types, while the country contains vast supplies of minerals, such as gold, silver, platina, rubies, emeralds, crystals, porphyry, salt, and sulphur. Since the conquest till the present time the yield of the precious metals is estimated at £130,000,000, mined chiefly in the departments of Canea and Antioquia. Mining operations, which had suffered much from the unsettled state of the country, have recently received a fresh stimulus by the introduction of foreign capital and improved engineering appliances. The metalliferous districts, which occur at various elevations, and especially along the river valleys, are stated to be generally salubrious, and foreigners are now enabled to purchase mines on the same terms as the natives. But the great natural resources of Columbia still lie almost untouched, chiefly through the lack of good and regular communications, the roads being generally impracticable for wheeled traffic, while the railway system is little developed. Besides the Panama, Bolivar, and Cucuta lines already open, others are in course of construction in the departments of Canea, Antioquia, Cundinamasca, Tolima, and Santander. The great water highway of the Maddalena has a fleet of twenty-five steamers, and is connected with the seaport of Cartagena by the Digue, a navigable canal branching off at Calamar. The yearly imports from Europe and the United States average £3,000,000, and the exports £1,600,000. The revenue for 1887–88 is estimated at £4,000,000, the expenditure £4,600,000, and the public debt £4,500,000, half internal and half foreign. The Government has still at its disposal extensive domains, which are granted on favourable terms to immigrants as well as to native and foreign speculators. At present the country is in the enjoyment of profound peace, with improved external and internal relations, and a general desire to close once for all the era of aimless political revolutions.

JOURNAL OF THE ROYAL AGRICULTURAL SOCIETY.[1]

THE most recent number of this Journal well keeps up the credit of its predecessors in spite of the grievous loss the Society sustained a year ago in the death of its talented editor, Mr. H. M. Jenkins. The contributors include the Earl of Coventry, Sir F. Bramwell, F.R.S., Drs. J. Voelcker and P. Vieth, Major Craigie, Principal W. Robertson of the Royal Veterinary College, Mr. James Macdonald, of Edinburgh, Messrs. Bernard Dyer, Albert Pell, Charles Whitehead, William C. Little, Charles Clay, Herbert J. Little, and others. Since these remarks were penned, we regret to hear of the sudden death of Principal Robertson, of the Royal Veterinary College.

The contents may be classified as—strictly agricultural, comprising articles on ensilage, sheep-feeding experiments, and reports on the prize-farm competitions in Northumberland; statistical, as presented in papers upon twenty years' changes in our foreign meat supply; engineering, as represented in trials of portable engines, and report of the consulting engineers at Newcastle; and purely scientific, as in papers on micro-organisms and their action on milk and milk products, on protective inoculation for anthrax and quarter ill, and on the progress of the Hessian fly.

Few of the papers possess such a wide general interest, both scientific and sanitary, as that of Dr. P. Vieth, on the action of micro-organisms on milk. Milk is subject to *lactic* fermentation, caused by the presence of a bacillus, consisting of short motionless rods propagating by segmentation. The effect of these bacilli is to cause the milk to sour and lose its liquid character, and assume the appearance of a gelatinous mass. The milk, in fact, "turns," and a separation of the curd from the whey follows, as though rennet had been added, but from a different cause. It is also now shown that lactic fermentation requires to be induced by the introduction of bacilli from without, after the milk is drawn from the cow, and that it is not inherent

[1] "Journal of the Royal Agricultural Society," Series II. vol. xxiii. Part II., 1887. (John Murray, Albemarle Street.)

in the milk. Lactic fermentation cannot take place unless in the presence of free oxygen, and at temperatures ranging from 50° to 114° F. Below and above these limits the process is arrested. The *butyric* fermentation is caused by a bacillus of larger size than that to which lactic fermentation is due, and occurs in milk free from lactic acid and of alkaline reaction. The bacillus of butyric fermentation will withstand a higher degree of heat, and the spores will stand a boiling heat for five minutes very well. *Alcoholic* fermentation is induced in milk which has already passed through the stage of lactic fermentation by means of a special ferment which has been used from time immemorial in the Caucasus under the name of kephir. By the action of this ferment a preparation similar, if not identical with koumiss is produced. *Slimy* fermentation gives what is known in Norway as ropy milk, where it is used as an article of diet. With this fermentation a micro-organism is also associated. Cheese is a product of fermentation from beginning to end. Not only is it a fermentative process by which the curd is separated from the whey, but the processes of ripening also depend upon various micro-organisms. It is generally thought that the differences between the cheese made in various localities, and which so well evade imitation, are due in a measure at least to the propagation and prevalence of micro-organisms of a sort which may be rare or wanting in other districts; and that consequently it may be easy to make cheese of a particular flavour or character in one district which it will be found impossible to produce in another district.

The able paper by Major Craigie, on twenty years' changes in our foreign meat supply, is well worth reading. The paper is deeply interesting to agriculturists, and deals with the probable sources of animal food for the constantly increasing human family. The enormous increase of population in the United States of America is especially noticed, and the following extract from the Commissioner of Agriculture's (Mr. Colman's) address to the "Cattle Kings" assembled at Chicago is significant and hopeful for the future of agriculturists:—"In 1880 we had 50,000,000 of inhabitants; in 1905 we should have 100,000,000; in 1930, 200,000,000; in 1955, 400,000,000; in 1980, less than 100 years hence, 800,000,000 of inhabitants. Where are these teeming millions to live? On what are they to subsist? Where and how are the cattle to be bred and reared that must be relied upon to furnish beef?" In answer to all of which questions we may be permitted to point out that many disturbing causes may operate to check this uniform future development of the population of the States. The wonderful results of geometrical progression have often astonished schoolboys; and as naturalists we also know what *ought to* happen in the case of insects, or even of mammals, if their actual increase in the least degree corresponded with their natural powers of expansion. Even the human family does not always increase as rapidly as it might. Stress is laid upon the fact that most of the available land for cattle-ranching has already been laid hold of, and that further extension of this industry has for the present received a check from which it is not likely to recover. Also the singular diminution in the numbers of sheep throughout the Old World, and the less noticed fact that since 1883 the sheep stock of the United States has lost 6,000,000, must bear upon the price of mutton sooner or later. In the United Kingdom, including islands, we had in 1867 111 sheep to every 100 inhabitants; in 1887 we have 79. In France they had in 1867 80 sheep to every 100 inhabitants, but in 1887 they only have 59. The same story is told in every European country without exception, and the sheep population of the world would have most disastrously decreased had it not been for the large increase in stocks in the Australasian colonies and the Argentine Republic.

The experiments upon ensilage are particularly worthy of attention. The process of ensilage has its devotees, who, like Prof. Rogers, consider it to be a panacea for agricultural distress. This sanguine view has been supported by the experience of many agriculturists, who have not the least doubt as to the superiority of silage over hay, and who also look upon the peculiar succulence of silage as a fact of great importance. One thing, however, appears certain—that, valuable as ensilage may be, it cannot equal in nutrient properties young growing grass. Hay or silage may be of more value in winter than is grass in summer, but intrinsically grass is that perfect product of unaided Nature which no art can better.

An optimist view thus stated may be challenged, and the propounder asked if the fresh clusters of the grape are equal to the ripened vintage wine? The matter requires to be dealt with scientifically, and it is with a view to clearing up the matter that the Royal Agricultural Society has with the aid and concurrence of the Duke of Bedford carried out a series of crucial experiments upon the value of ensilage as a stock food in comparison with the value of hay. Such an experiment is liable to many sources of error. The Wilmington experiments of 1886 abounded in them. There was no guarantee that the hay as hay was as good as the silage as silage. There was no record as to the comparative areas of land required to produce the hay or the silage. The large amount of silage eaten by the bullocks bore an unsatisfactory relation to the small quantity of hay eaten, indicating that the ensilage was good and palatable, while the hay was unpalatable. This inference is borne out by the *dictum* of the Society's chemist, that the hay at Wilmington was "very inferior indeed," while the silage "was really well made." Such sources of error invalidate the results obtained, and if, as was the case, the cattle fed on good silage did better than those fed on bad hay, all we can say is that no other result could very well have been expected. At Woburn the experiments were more strictly conditioned. "$5\frac{1}{2}$ acres of ground were carefully measured out, and the grass was only cut as it was wanted for carting to the silo, not being allowed to lie on the field any length of time. Two carts going side by side were filled simultaneously, and then taken to be weighed. After weighing, one cart went to the silo, into which grass was to be filled, and the other went to a meadow, where the grass was spread and left for haying." I must not take up space by explaining the complete system of sampling the grass, and the two products of hay and silage. Suffice it to say that the utmost pains was taken to obtain thoroughly representative samples for purposes of analysis. The hay and silage thus obtained might be considered as strictly comparable with one another, and if the process of silage is preferable to the older and more fragrant system of hay-making, the comparison might here be instituted with every prospect of deciding the question. The experiment was made upon twelve Hereford steers, six of which were placed on a diet of 3 lbs. of cotton cake, 5 lbs. of maize meal, with hay *ad libitum* and water *ad libitum*. The other six were given 3 lbs. of cotton cake, 5 lbs. of maize meal, with silage *ad libitum*, and water *ad libitum*. The conditions were the same except with regard to the hay and the silage. The bullocks were practically of equal size and weight, although the six bullocks which were placed on the ensilage side of the experiment had the advantage of 9 lbs. over the hay-fed lot, and weighed 60 cwt. 1 qr. 20 lbs. The result after thirty days' feeding was that the hay-fed bullocks had increased more in weight, the comparative merits of the two systems of feeding being as follows:—

Gain per day per head of bullocks receiving hay . 2·3 lbs.
Ditto ditto ditto silage . 2·1 lbs.

During the succeeding month the result was in favour of the ensilage, but in the total period of 84 days, which terminated on March 10, 1887, the result was:—

Gain of hay-fed bullocks . . 1·96 lbs. per day.
Ditto silage ditto . . . 1·98 lbs. ditto.

A very curious result was arrived at with reference to the relative amounts of hay and water and of silage and water consumed during this period. The six bullocks receiving hay consumed of hay 20·3 lbs per head per day, and drank 70·7 lbs. of water, or a total of hay and water of 91 lbs. each. The six bullocks receiving silage consumed of silage 51 lbs. and of water 40·1 lbs., or a total of 91 lbs. each. This very closely accordant result appears to point to the conclusion that the only difference between hay and silage is water, and that hay with plenty of water is quite as good a food for fattening bullocks as silage with less water.

The progress of the Hessian fly is a topic of considerable public interest, and no one could more satisfactorily enlighten us on the subject than Mr. Charles Whitehead. We are told by this excellent practical entomologist that the Hessian fly appeared first in America in 1779, and that a great scare prevailed in England at that time, which turned out to be unfounded. The nearest country to us at present affected with the pest is Russia, which appeared to first receive this unwelcome visitant in 1879, and it is still a moot point whether our Hessian flies have arrived from America or from Russia. That we have it rather bad is plain from the fact that the insect has been proved present in twenty English counties. The theatre of its operations is likely

to be extended during next summer, and we shall probably soon have the satisfaction of knowing whether our climate is suitable to its tastes. If so, it will probably obey the mandate of increasing and multiplying; but its tendency will be towards deplenishing rather than replenishing the earth. The prospect is not exactly nice, but we may take some comfort from Prof. Riley's expressed opinion that the Hessian fly will not prove a very serious plague to British agriculturists.

Downton, December 10. JOHN WRIGHTSON.

THE REPRODUCTIVE ORGANS OF ALCYONIDIUM GELATINOSUM.

IN some specimens of the Polyzoon *Alcyonidium gelatinosum* dredged last summer, I noticed that the colony, in place of being nearly homogeneous in colour and semi-translucent, as is usually the case, had a blotched appearance, caused by the presence of a number of small rounded spots of an opaque grayish-white or pale yellow colour. These average about 0·5 mm. in diameter, and are scattered irregularly through the colony. On teasing up a small part in sea-water, and on making a few rough sections of the living colony, I found that the opaque spots were cavities filled with fully developed active spermatozoa. No ova were visible in the polypides of any of the parts examined, so these colonies were evidently in the condition of sexually mature males. It at once occurred to me that this species of *Alcyonidium* might be unisexual—some colonies male and others female—the males being distinguishable when mature by their spotted appearance. The specimens were preserved for future examination.

On returning to Liverpool, and looking up the literature of the subject, I find that Hincks states ("British Marine Polyzoa," introduction, p. lxxxvi.) that "*Alcyonidium gelatinosum*, according to Kölliker, is unisexual," and I gather from the context that it is the individual polypides that are unisexual, and not the whole colony. Hincks, however, does not give a reference to any paper by Kölliker, and I have not been able to find in the literature of the Polyzoa, or in the bibliographies I have consulted, any paper of Kölliker's which would be likely to contain observations on the reproduction of *Alcyonidium*; therefore I am still uncertain how far Kölliker's remark is intended to apply—to the whole colony, or only to the individual polypides. I know of no other investigations on the subject.

I have now examined a number of thin sections, of both the spotted colonies (including the one formerly dissected) and the usual translucent ones, and I find:—

(1) In the spotted colonies there are a number of greatly distended polypides, with their cœloms filled with fully developed spermatozoa. There are also a few ordinary large, but not distended, polypides, containing each a few young ova.

(2) In the ordinary clear colonies there are neither ova nor spermatozoa to be found.

It is evident, then, that the *colony* is hermaphrodite, whatever the polypide may be. But it is also evident that the spotted colonies are virtually males. Their spermatozoa are fully developed, while their ova are still quite immature. Probably, then, *Alcyonidium gelatinosum* is, like many of the Compound Ascidians, an hermaphrodite in which the reproductive systems arrive at maturity at different times in the life-history. Most of the Compound Ascidians in which I have found this the case are proterogynous (the female organs maturing first), but *Alcyonidium gelatinosum* appears to be proterandrous. If the polypides are unisexual, then the proterandry refers only to the colony as a whole, but it is possible that each polypide may be a proterandrous hermaphrodite, developing ova after it has got rid of the spermatozoa. I hope to investigate this matter further by keeping some colonies alive at the Puffin Island Biological Station, and examining their condition from time to time.

In *Alcyonidium gelatinosum* both the ova and the spermatozoa occur in ordinary polypides, and not, as Hincks states is the case in the closely related species *A. mytili*, in "gonœcia" (cells containing no polypides). In my sections the alimentary canal and tentacles are found cut across here and there in the masses of spermatozoa. The large cavities containing the spermatozoa are evidently ordinary polypides, with the cœlom greatly distended.

W. A. HERDMAN.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 15.—"Note on the Development of Feeble Currents by purely Physical Action, and on the Oxidation under Voltaic Influences of Metals not ordinarily regarded as spontaneously oxidizable." By Dr. C. R. Alder Wright, F.R.S., and C. Thompson, F.C.S.

The authors have noticed that if two or more different kinds of aëration plates be set up on the surface of the fluid contained in a shallow basin in which the oxidizable metal is immersed, and sufficient time be allowed to elapse to enable the films of air attracted to the aëration plates to attain a condition of equilibrium, different constant values are usually obtained for the E.M.F.'s generated by opposing to the oxidizable metal first one and then the other of any given pair of aëration plates, the currents generated being rendered throughout of too small density for "running down" to take place during the observations by interposing a large resistance in the circuit. If when this state of constancy has been attained the two aëration plates be opposed to each other with a considerable resistance in circuit, a current passes from the one giving the higher value when opposed to the oxidizable plate through the external circuit to the other; this current at first is of such magnitude as to correspond exactly with the E.M.F. due to the difference between the E.M.F.'s exhibited when the two plates respectively are opposed to the oxidizable metal; but after some time it gradually diminishes; even after several days, or even weeks, however, it is usually still measurable; and if a miniature silver voltameter be included in the circuit, in many cases an appreciable amount of crystalline silver is found to be slowly deposited on the negative electrode of the voltameter, which may conveniently be a thin gold wire immersed to a depth of a few millimetres in silver-nitrate solution, a silver plate or wire forming the positive electrode. Various experiments are described in illustration.

It is obvious that during the passage of a current the dilute sulphuric acid between the two plates must be electrolysed, so that hydrogen would tend to be liberated on the surface of the plate acquiring the higher potential, and oxygen on that of the other; the hydrogen whilst nascent would necessarily be more or less completely oxidized to water by the oxygen of the film of condensed air; so that on the whole the net chemical action in the cell itself would be either *nil* (if all hydrogen were so reoxidized) or one *absorbing* heat (if some of the hydrogen escaped oxidation). The oxygen slowly evolved would escape as such, being dissolved by the surrounding fluid. The effect of this should accordingly be that the efficiency of the air-film on the first plate would be more or less depreciated, and that on the second exalted; in point of fact, if the two aëration plates in such an arrangement which has been generating a current for some time be (by means of an appropriate switch) disconnected from one another and successively opposed to a given oxidizable plate, the one does give a considerably lower and the other usually an appreciably higher value than the constant ones previously obtained (before the two aëration plates were directly opposed to one another) on opposing each severally to the oxidizable metal; whilst on allowing the cell to stand for some time generating no current, the lower value gradually rises and the raised one falls until sensibly the old constant values are again obtained.

When *silver* plates are used in conjunction with a fluid capable of dissolving silver oxide (such as dilute sulphuric or acetic acid or ammonia solution), distinctly larger amounts of current are usually developed than with platinum or gold plates, and simultaneously silver passes into solution, the plate acquiring the lower potential diminishing in weight, and, in short, behaving precisely as though it were an oxidizable metal, such as zinc or copper. Obviously this is due to the circumstance that with silver the ion liberated attacks the metal of the plate acquiring the lower potential; but the remarkable part of the action is that this attack is only partial, so that the amount of silver dissolved is invariably *less than that equivalent to the current passing*, *i.e.* less than that deposited in a silver voltameter included in the circuit.

Various illustrative experiments are described which show that the difference between the silver dissolved and that deposited by the current is relatively much larger with the weakest currents.

It is obvious that if silver will dissolve in acids, &c., under the comparatively feeble oxidizing influence of an aëration plate,

much more rapid solution might be anticipated by substituting for such a plate platinum immersed in a powerfully oxidizing fluid such as strong nitric acid, or sulphuric acid solution of chromic anhydride. In point of fact, the authors have found that on setting up such cells where the silver was immersed in dilute sulphuric acid (*i.e.* Grove's cell with silver instead of zinc, and so on), electromotors of notable power are produced, at any rate until the silver plate becomes coated with sparingly soluble sulphate. Even in these cases, however, perfect correspondence between the amount of silver dissolved and that deposited in a voltameter included in the circuit does not subsist, the latter being always measurably the greater.

Just as silver is capable of being dissolved in an appropriate fluid when opposed to an aëration plate, so may several other metals not ordinarily prone to atmospheric oxidation; thus mercury with dilute sulphuric acid as fluid, and an aëration plate of platinum sponge, generates a measurable continuous current, forming *mercurous sulphate* in so doing, so that after some time the liquid becomes turbid through separation of that sparingly soluble salt, and the filtered fluid precipitates calomel on addition of dilute hydrochloric acid. Acetic acid acts similarly, but far less energetically. Potassium cyanide solution, on the other hand, causes a much more rapid solution of mercury, forming *mercuric potassiocyanide;* it is noticeable that in this case only 100 parts of mercury go into solution for 108 of silver deposited in the voltameter, whereas when sulphuric acid is used 200 parts of mercury become sulphate per 108 of silver deposited.

If gold be substituted for mercury in this latter arrangement, rapid solution takes place with formation of *aurocyanide of potassium,* 196 parts of gold being dissolved per 108 of silver thrown down in the voltameter. Palladium behaves precisely as gold, 52 parts of metal being dissolved per 108 of silver deposited; local action sometimes causes in each case a slight *excess* of amount dissolved relatively to the current passing, the opposite result to that observed with the silver cells above described.

Of course, if more powerful oxidizing agents are used than simple aëration plates (such as platinum in sulphuric-chromic solution) the action goes on in all such cases still more rapidly.

"On the Functions of the Occipital and Temporal Lobes of the Monkey's Brain." By Dr. Sanger Brown and Prof. E. A. Schäfer, F.R.S.

The authors gave an account of experiments upon the brain of monkeys, involving the removal of the occipital and temporal lobes respectively. These experiments show that removal of the whole of one occipital lobe produces permanent hemiopia, and that removal of both occipital lobes produces complete and permanent blindness of both eyes; and, further, that for the production of these effects it is not necessary that the angular gyrus should be involved in the lesion.

They also show that not only the superior temporal gyrus but even the whole temporo-sphenoidal lobe can be removed on both sides of the brain in monkeys without producing any appreciable permanent effect on hearing.

The reading of the paper was illustrated by diagrams exhibiting the extent of the lesions, as well as by casts of the brains.

Royal Meteorological Society, December 21.—Mr. W. Ellis, President, in the chair.—The following papers were read:—The mean temperature of the air at Greenwich, from September 1811 to June 1856, by Mr. H. S. Eaton. This is a discussion of the meteorological journals of the late Mr. J. H. Belville, and those of the Royal Observatory. The general results of this investigation are:—(1) That there was no appreciable change in the mean annual temperature of the air at Greenwich in the period 1812 to 1855 inclusive. (2) That on the eminence on which the Royal Observatory is situated the average temperature at night, or rather the early morning, is in all cases higher than over the lower grounds. (3) That with a north-wall, or possibly a north-window exposure, higher maximum temperatures are found at the lower stations. (4) That the movements of the thermometer are retarded with a north-wall exposure as compared with an instrument on an open stand, especially where the situation is a confined one, the indications of the thermometer not following changes of temperature so promptly owing to the modifying influence of the adjacent building.—Report on the phenological observations for the year 1887, by the Rev. T. A. Preston. The past season was a most exceptional one. For flowers it was disastrous; fruit was generally a failure, though there were exceptions; those kinds which promised well turned out very small or spoilt by insects. Vegetables were universally poor, roots were destroyed by insects or drought, and green crops soon passed off. The wheat crop, however, was better than was expected. Barley on light lands was poor, but that which was sown early was satisfactory. Meadow hay was not up to an average crop, but clover and seed hay were much more nearly so. In Kent the fruit crops turned out lighter than usual, but the prices have ruled higher.—Earth tremors and the wind, by Prof. John Milne, F.R.S. The author has made a detailed examination of the tremor records obtained in Tokio, and compared them with the tri-daily weather maps issued by the Imperial Goverment of Japan. From this comparison the following conclusions have been drawn:—(1) Earth tremors are more frequent with a low barometer than with a high barometer. (2) With a high barometric gradient tremors are almost always observed, but when the gradient is small it is seldom that tremors are visible. (3) The stronger the wind the more likely it is that tremors should be observed. (4) When there has been a strong wind and no tremors the wind has usually been local, of short duration, or else blowing inland from the ocean. (5) When there has been little or no wind in Tokio and yet tremors have been observed, in most cases there has been a strong wind in other parts of Central Japan. (6) From 75 to 80 per cent. of the tremors observed in Tokio may be accounted for on the supposition that they have been produced either by local or distant winds. (7) The only connection between earth tremors and earthquakes in Central Japan is that they are both more frequent about the same season.—Pressure and temperature in cyclones and anticyclones, by Prof. H. A. Hazen. The author has made a comparison of the observations at Burlington and on the summit of Mount Washington, U.S.A., and as the result of a study of about 4000 observations from two days before till two days after the passage of cyclone and anticyclone centres, he has arrived at the following conclusions:—(1) In both cyclones and anticyclones the pressure lags from 10 to 11 hours at the summit of Mount Washington. (2) The temperature change at the base precedes very slightly the pressure change, but at the summit the change occurs nearly 24 hours earlier. (3) The temperature appears to be a very little earlier at the summit than at the base, and certainly varies much more rapidly at the former. (4) In a cyclone the difference in temperature between base and summit is less than the mean before the storm, but the difference rapidly increases after the centre has passed. Just the contrary is true in an anticyclone. (5) The total fall in pressure in a cyclone at the summit very nearly equals that at the base, and likewise the rise in an anticyclone. (6) The fluctuation of temperature—that is, from the highest to the lowest—at the summit is double that at the base in a cyclone; but it is only a little greater in an anticyclone.

EDINBURGH.

Royal Society, December 5.—The Hon. Lord Maclaren, Vice-President, in the chair.—After reading an opening address, the Chairman presented the Victoria Jubilee Prize to Sir W. Thomson, for his contributions to the Society's publications on various subjects in hydrokinetics.—Sir W. Thomson read a paper on Cauchy's and Green's doctrine of extraneous pressure to account for Fresnel's wave-surface. The object of his investigation was to place Green's treatment of the subject on a more satisfactory basis than it had been left by its author.—Sir W. Thomson also exhibited models of the minimal tetrakaidekahedron, a figure which he discusses in the *Philosophical Magazine* for this month.—The second part of a paper on micro-organisms, by Dr. A. B. Griffiths, was communicated by Prof. Crum-Brown.—Prof. Wallace laid on the table a paper on the blackening of the skin of domesticated animals in tropical regions.

PARIS.

Academy of Sciences, December 19.—M. Janssen in the chair.—Generation of algebraic surfaces of any order, by M. de Jonquières. The theorem here demonstrated supplies a fresh instance of the intimate and essential part played by the properties of numbers in several questions of general geometry, and especially in those concerned with the generation of surfaces and curves, as well as with the number of double and multiple points with which the latter may be endowed.—Reply to M. Wolf's communication entitled, "Comparaison des divers systèmes de synchronisation des horloges astronomiques," by

M. A. Cornu. The regulating apparatus introduced into his system of synchronizing clocks by M. Cornu, and objected to by M. Wolf as useless and even inconvenient, is shown to be free from these drawbacks, and in fact indispensable for strict accuracy. To these remarks M. Wolf replies that the system at work at Greenwich for twenty-seven and in Paris for seventeen years dispenses altogether with any such arrangement as that proposed by M. Cornu.—On the cause of the deviation of the arrows indicating the direction of the wind on synoptical charts of cyclones, by M. Faye. This deviation is traced entirely to the friction or resistance of the ground over which the cyclone is moving, and harmonizes in no way with the erroneous hypothesis of ascending cyclones. It is greater on land than at sea, and imperceptible in the case of waterspouts and true tornadoes. It also diminishes with the distance from the centre of the cyclone, disappearing altogether near the central calm.—On the state of the sulphur and phosphorus present in plants, in the ground, and in cultivated soil, and on their quantitative analysis, by MM. Berthelot and André. Having already studied the relations of potassium and nitrogen to the vegetative functions, the authors here deal in the same way with sulphur and phosphorus. The question is treated especially with a view to determining and analyzing the complementary manures best suited for restoring the fertility of exhausted lands. —Note, by M. Albert Gaudry, on the discovery of a gigantic turtle by Dr. Donnezan. This specimen was found, with numerous other fossils, in the Middle Pliocene of Perpignan during the recent excavations connected with the erection of the fortress of Serrat in the Eastern Pyrenees. The carapace, 1·20 metre long, was extracted with great difficulty from the hard rock in which it was completely embedded, the innumerable fragments being carefully put together by Dr. Donnezan, by means of about a thousand brackets. This turtle, which he has named *Testudo perpiniana*, and which he has presented to the Paris Museum, considerably exceeds its living congeners, being equal in size to the *T. grandidier*, a sub-fossil species found in Madagascar. Its survival down to the close of the Middle Pliocene is important for the study of the Glacial period, tending to show that the south of France even then still enjoyed a warm climate. —Experiments with a new hydraulic machine employed for irrigating-purposes, by M. A. de Caligny. By means of this apparatus, which is a modified form of that described by the author in the *Comptes rendus* for December 18, 1882, water with a normal fall of 2·40 metres may be raised to a height of 9·45 metres above the level of the upper stream.—On the degrees of oxidation of chromium and manganese in their fluorescent compounds, by M. Lecoq de Boisbaudran. With a view to solving this question, the author describes certain experiments which he has made, chiefly with alumina and chromium, gallina and chromium, magnesia and chromium, alumina, potassa, and manganese, lime and manganese; confining himself for the present to a statement of the facts observed. —Elements and ephemeris of the planet Anahita, 270, by M. E. Viennet. By means of the ephemeris deduced from the already published provisional elements the author has been enabled to compare all the observations made down to November 16, and thus determine six normal places for October 12, 15, 18, 21, 27, and November 16. With these fresh elements an ephemeris has been calculated, by which astronomers will be enabled to observe the planet down to the end of the present opposition. The magnitude should then be about 11 or 12.—On the value of the solar parallax deduced from the observations taken by the Brazilian Missions during the transit of Venus in 1882, by M. Cruls. From the reports of the observations made at the three stations of St. Thomas (West Indies), Olinda (Brazil), and Punta-Arenas (Strait of Magellan), the horizontal equatorial parallax of the sun at its mean distance from the earth is found to be $8''·848 - 0''·040 = 8''·808$. The reports are now nearly printed, and copies may soon be expected in Europe.—On the specific heat of tellurium, by M. Ch. Fabre. These experiments show that under its several forms tellurium possesses much about the same specific heat, at least at a temperature of 100° C. or thereabouts. But the differences may possibly increase at higher temperatures, and especially near the point of transformation from amorphous to crystallized tellurium. —Study of a specimen of Welsh coal, by MM. Scheurer-Kestner and Meunier-Dolfus. This was a piece of the so-called "Nixom's Navigation," from Glamorgan, which the authors undertook to examine for Mr. Donkin, and which was found to be so pure that it yielded 88 per cent. of hard bright coke, 4·39 of hydrogen, and not more than ·69 of sulphur.—On sidereal evolution, by M. Ch. V. Zenger.

Berlin.

Physiological Society, December 2.—Prof. du Bois Reymond, President, in the chair.—Dr. Salomon spoke on the physiological action of paraxanthin. Since Fisher's researches have thrown light on the chemical constitution of caffein and theobromin, and shown that the former is trimethyl-xanthin, the latter dimethyl-xanthin, experiments on the physiological action of caffein, theobromin, and xanthin have acquired an increased interest. All these substances produce a double effect when given to a frog—namely, one on the central nervous system, and a curious effect on the muscles, which pass into rigor; the three substances exhibit these properties in graduated degree, a fact which is sufficiently explained by the close relationship of their chemical constitution. It hence appeared to the speaker to be a matter of some importance to investigate the physiological action of the two xanthin-derivatives which he had found in urine—namely, paraxanthin and heteroxanthin. From his researches it appears probable that paraxanthin was also a dimethyl-xanthin, that is, an isomer of theobromin; heteroxanthin, on the other hand, had only been obtained in such minute quantities that its chemical constitution could not be determined, but Dr. Salomon suggested that it might be the missing member in the above series of xanthin-derivatives—namely, monomethyl-xanthin. When the somewhat insoluble paraxanthin was administered locally by subcutaneous injection, it produced a stiffness and rigor of the neighbouring muscles: when given in larger doses, some of the animals became sluggish and died, but in many cases they remained uninjured. When given internally, paraxanthin rarely led to any appearance of poisoning, but, when it did, the effect was limited to a stiffening of the fore-limbs and a general sluggishness of the whole animal. Paraxanthin, therefore, exhibited a physiological action analogous to that of the other xanthin-derivatives. Paraxanthin also possesses a distinct action on the respiratory apparatus, since, in all cases in which any effect was produced, the lungs were found to be strongly inflated. He was unable to examine the action of heteroxanthin, from the smallness of the quantity in which it can be obtained.—Dr. Baginski demonstrated the reducing action of certain Bacteria, using, as a reagent, methylene-blue, which becomes colourless by reduction. The Bacteria were obtained from the intestines of healthy cows. Both *Bacterium lactis* and *Bacterium coli* produced a powerful reducing action in pure cultivations, where the nutrient fluid was coloured with methylene-blue; in those places where oxygen had access the blue colour reappeared. A third Bacterium discovered by the speaker exhibited no reducing power.—Prof. Gad explained, on behalf of Mr. Donaldson, the method introduced by Prof. Martin, of the Johns Hopkins University, Baltimore, of isolating the mammalian heart, and of making observations on its activity for several hours, when isolated from the body and connected only with the lungs. The defibrinated blood which flows from the aorta passes into two Mariotte flasks which are in communication with each other, and thence into the right auricle. By means of this arrangement it can be shown that the heart, when separated from all its nerves, works quicker when the temperature of the blood is raised, and slower when it is lowered. An increase of pressure in the aorta was found to be without any effect, whereas an increased venous resistance increases the cardiac activity. It could not be shown that the heart exerts any suctional action during its diastole.

Meteorological Society, December 6.—Prof. von Bezold, President, in the chair.—The President drew attention to Prof. Hann's two most recent publications, namely, the "Atlas of Meteorology" and "The Barometric Pressure in Middle and South Europe according to Observations extending over Thirty Years," and gave a short account of their contents.—Dr. Assmann gave an account of the experiments he has carried on during the last year and a half with a view to determining the true temperature and humidity of the air. After describing the methods previously used to determine the true temperature of the air and his own unsuccessful attempts before he arrived at a satisfactory result, he explained the principle of the thermometers as finally employed, and demonstrated the same by exhibiting several of them. These instruments consist of a fine sensitive mercurial thermometer, of which the small bulb is surrounded by a highly burnished cylinder of nickel-plated brass, open at the lower end.

At the upper end the brass cylinder has a lateral opening by which its interior can be connected with an india-rubber aspirating ball. The chief difficulty met with was in the construction of a suitable valve for the aspirating ball. Finally he succeeded in making a valve such that no air was ever driven back towards the thermometer when the ball was compressed, but only drawn over the bulb of the instrument during the aspiration at the rate of ·2 to 2·5 metres per second. Within these limits the rate at which the air is drawn over the bulb had no influence on the temperature recorded by the thermometer. Of extreme importance, as showing the suitability of the instruments, were the speaker's observations on the temperatures recorded by two of his thermometers, of which one was exposed to the direct rays of the sun, while the other was shaded by a distant shutter: the two thermometers recorded the same temperature, while at the same time an actinometer exposed to the sun showed a temperature 17° C. higher. The same exactness in the determination of the humidity of the air is obtained when a pair of these thermometers is used, and the bulb of one is wrapped round with a piece of moist cloth. This instrument is specially suitable for observations in a balloon. The speaker explained that only shortly before the present meeting he had found that a similar instrument had been constructed by Welsh about the year 1850.—Dr. Robert von Helmholtz gave an account of experiments which he had carried on conjointly with Dr. Sprung with a view to determining the humidity of the air. They had both arrived, independently of each other, at the idea that the determination of the dew-point might best be made, not, as in the usual way, by the condensation on the bulb of a thermometer, but by measurement of the amount of rarefaction which the air must undergo in order that a mist may be produced. In a previous research the speaker, when determining the vapour-tension over solutions of salts, had compressed the air in a closed space, and then obtained a formation of mist by suddenly reducing the pressure again to that of the atmosphere. By determining the general excess of pressure which is thus requisite, the dew-point may be determined. Dr. Sprung has compared the dew-point as thus determined and as obtained by Regnault's apparatus. The experiments are not yet carried sufficiently far to yield any numerical results, but even now it may be said that this new method of determining the dew-point is extremely trustworthy.

Physical Society, December 9.—Prof. du Bois Reymond, President, in the chair.—Dr. Badde developed the mathematical formulæ by means of which he can determine the vibrational condition not only of a vibrating string, but also of a square plate—formulæ which make it possible to determine the relation between the pitch of the note and the vibration-amplitude of the vibrating plate.—Dr. Pringsheim gave an account of the experiments he has made, in conjunction with Dr. Summer, to determine the quotient (k) of the specific heat of gases. The value of k is determined either by measuring the rate of propagation of sound in gases which obey Mariotte's law, or else from the ratio of temperature to pressure when the volume is kept constant. Up to the present time the rate of transmission of sound has not been so exactly determined that the values can be used for deducing the value of k. Similarly the second method has as yet given very discordant results, while at the same time the experiments have not been free from errors. Drs. Pringsheim and Summer have compressed air in a glass balloon whose capacity was sixty litres, and determined its temperature by means of a fine silver wire passing through it whose electrical resistance was known. Hereupon the pressure in the balloon was allowed to sink to that of the atmosphere by opening a tap leading into it, and the cooling thus produced measured by means of the wire. Immediately upon this the tap was again closed, the air becoming warmed by the heat which passed into it from the air surrounding the balloon, and the rise of temperature again measured. During these experiments it was found to be of no consequence whether the rarefaction of the compressed air took place rapidly through a tap with a large bore, or through one with a narrow aperture; the wire always showed the same amount of cooling, thus proving that it follows the alteration of temperature of the air very rapidly. Similarly the length of the wire was found to have no effect on the results, thus showing that the temperature of the surroundings has no influence on the temperature recorded by the wire. The resistance of the wire was determined by the bridge-method, partly by means of a galvanometer, partly by means of a telephone. The ratios of the alterations in resistance of the wire to alterations of temperature were determined, within the necessary limits, for several fine wires. The speakers considered that the only objection which can be raised to their experiments is that the above determination was not made with the same wires which were used in their experiments, and they propose to do away with even this objection by some later experiments which have not as yet been carried out. All other possible objections have been set aside by varying the conditions of their work while obtaining constant results. As a mean of the separate measurements they obtained as a value for k the number 1·384; the deviation for the mean value amounted only to a few hundredths per cent. The above value for k cannot however be taken as being absolute until it has been proved that there is a proportionality between the temperature and resistance of the silver wire which they used in their experiments.

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